AUG 5 192

IN THIS ISSUE:

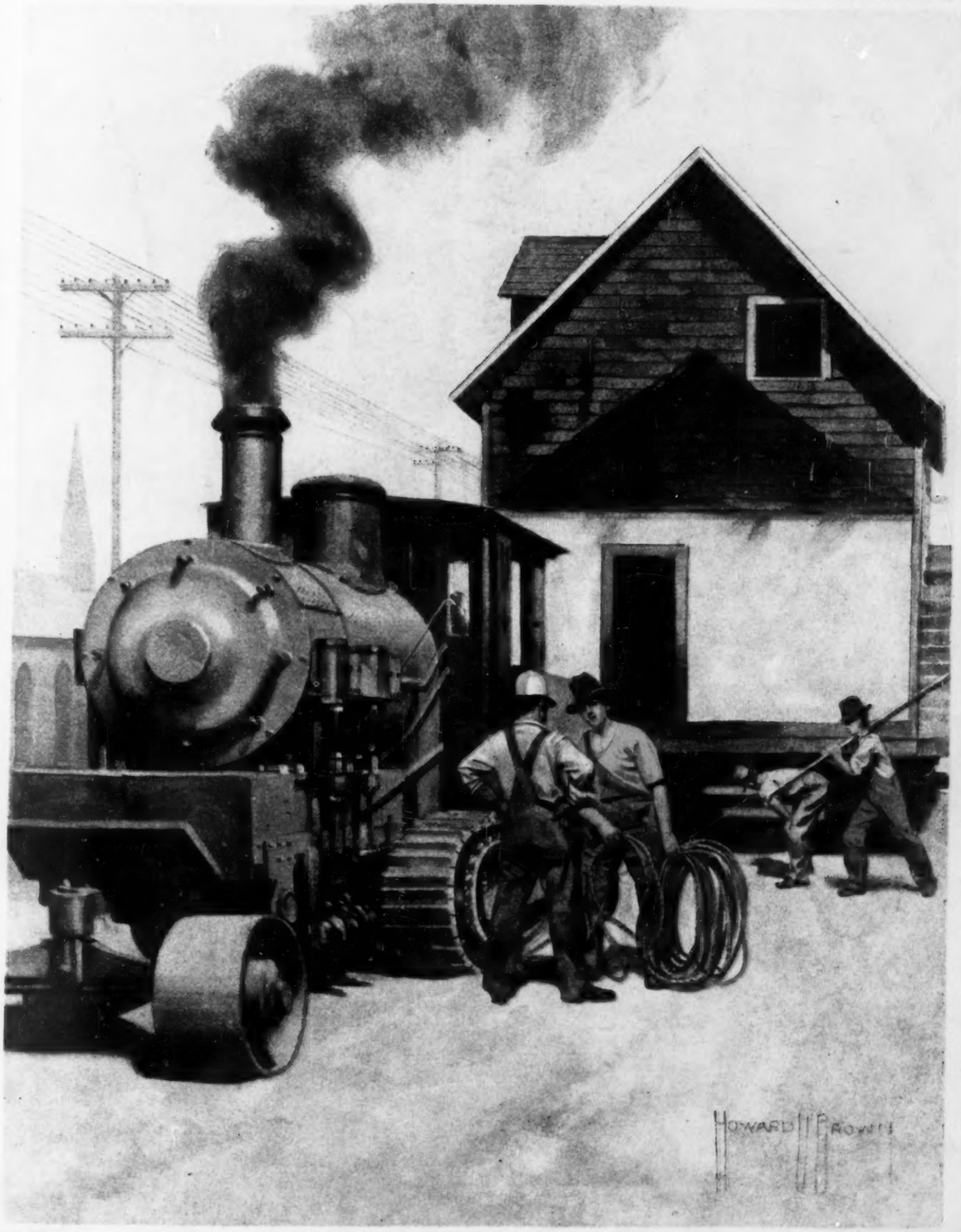
DEPTH BOMBING FROM THE AIR
WHERE OIL OCCURS

GENERAL LIBRARY
AUG 192
UNIV. OF

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

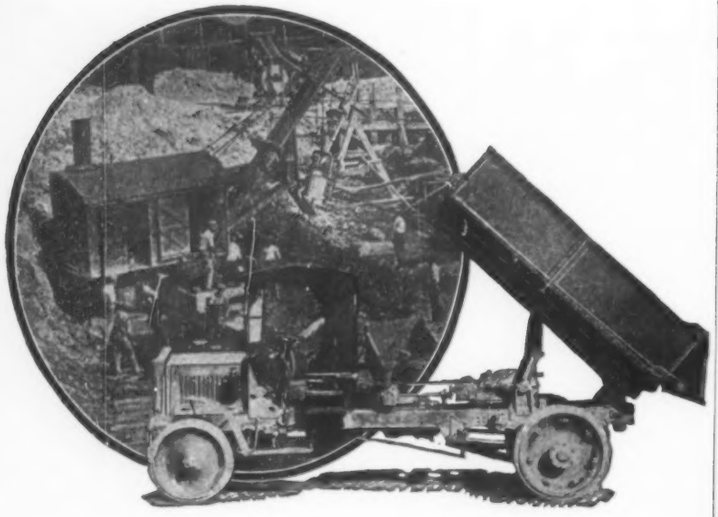


MOVING AN ENTIRE SECTION OF A TOWN TO MAKE ROOM FOR MINERS.—[See page 95]

Vol. CXXV. No. 6
August 6, 1921

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

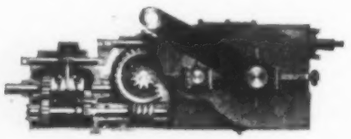
Price 15 Cents
20 cents in Canada



Positive Control

THE Van Dorn Horizontal Hoist is connected to the body by a link and arm arrangement which insures positive control of the body. There is absolutely no danger of the body tilting suddenly under the sliding load. The body can be stopped and locked, or lowered from any dumping angle up to 45°. The truck can be in motion while the body is being raised or lowered, the hoist stopping automatically when the body is tipped at a 45° angle or is lowered to its bed.

Every truck operator should have the Van Dorn bulletin explaining the principle and operation of Van Dorn Vertical and Horizontal Hoists. Write for your copy.



Cut away side view of the Van Dorn Horizontal Hoist. The power of the motor is transmitted through a series of gears to a 300 to 1 ratio and is employed to end dump, side dump or directly elevate the body.

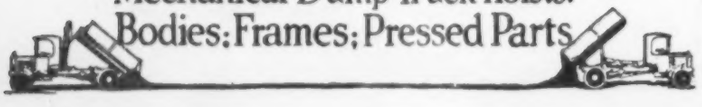
THE VAN DORN IRON WORKS COMPANY

Cleveland

Branches 324 William St., Long Island City, N. Y., and 451 Bourse Bldg., Philadelphia
Distributors in all other cities

Van Dorn

Mechanical Dump Truck Hoists:
Bodies; Frames; Pressed Parts

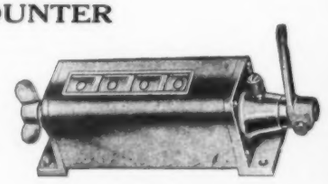


Buy production at "so much per"

You can sell only *measured* production; why pay operatives for anything else? Buy the production from your employees on as businesslike basis as you sell it to customers! Have each man's output (his "bill of goods" to you) *measured* or *counted* by a

Veeder
COUNTER

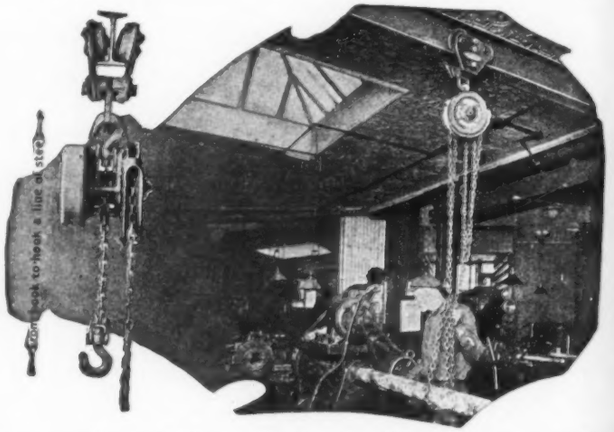
This small **Rotary Ratchet Counter** (No. 6) counts reciprocating movements of the lever, as required in recording the product of the smaller stamping presses. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adaptable to no end of small machines, simply by regulating the throw of the lever. Price $2.00.
(Cut nearly full-size.)



This large **Set-Back Rotary Ratchet Counter** records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50. (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra.
(Cut less than half size)

Any machine where you want to push down the production-cost is a good place to put on a Veeder. You'll find just the counter for your try-out if you'll thumb through the Veeder booklet—certainly the copy's free.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.



Are your handling costs eating into profits?

GIVE your machine operators *labor-saving* helpers—the kind that work for practically nothing per week.

The Yale Spur-Geared Block and I-Beam Trolley System, pictured above, is used for lifting heavy pipe and swinging it into position on the threading and cutting-off machines.

One man does it all without a helper, easily and quickly. This is the Yale Way.

Other units of the Yale Hoisting and Conveying System include Screw-Geared and Differential Chain Blocks, Electric Hoists, Electric Industrial Trucks, Tractors and Trailers. Write for further information about the Yale Way.

Yale Made is Yale Marked

The Yale & Towne Mfg. Co.

Makers of Yale Products: Locks, Hoists and Electric Industrial Trucks

Stamford, Conn. U. S. A.

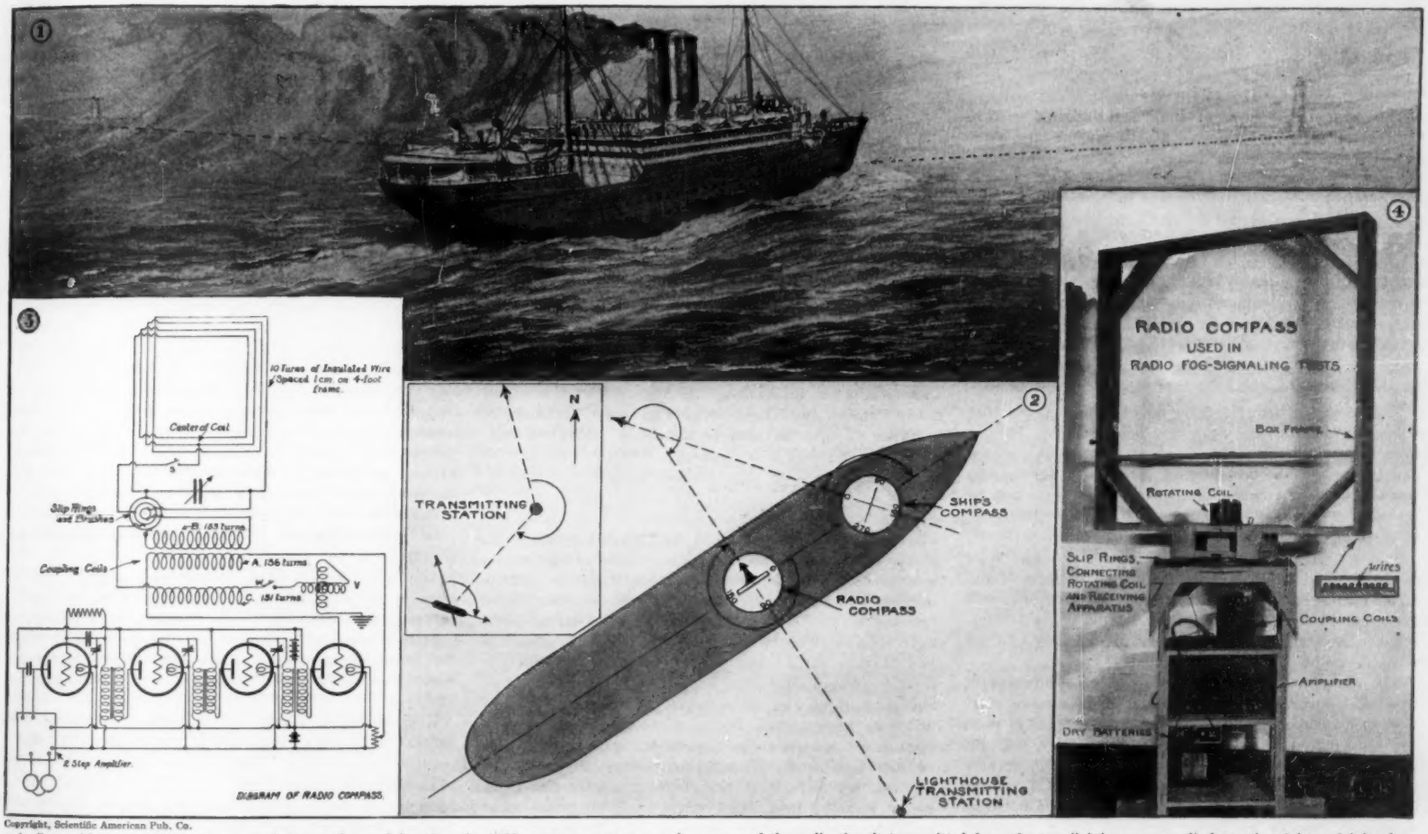
YALE Hoisting and Conveying Systems

SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXV. NUMBER 6 | NEW YORK, AUGUST 6, 1921 | 15 CENTS A COPY 20 CENTS IN CANADA



Copyright, Scientific American Pub. Co.

1. Steamship approaching the coast during a fog and locating the hidden entrance to a port by means of the radio signals transmitted from the two lighthouses seen dimly to the right and left of the vessel. 2. Diagrammatic presentation of the manner in which the magnetic compass and the radio compass are used in conjunction with wireless signals transmitted from a lighthouse. 3. Scheme of wiring employed in a typical radio compass installation. 4. Typical radio compass outfit as used by the U. S. Lighthouse Service.

Details of the radio compass now used in navigating ships in safety during foggy weather

The Radio Compass and Navigation

By Robert G. Skerrett

PERHAPS it is too much to say that fog will be robbed of all of its perils to the navigator. But in view of recent developments in the radio compass it may be claimed that blanketing mists or driving snow will hereafter offer fewer dangers to the mariner. In this work for the promotion of nautical security, the Bureau of Lighthouses and the Bureau of Standards of the U. S. Department of Commerce have conjointly made valuable and important contributions of late.

As is pretty well known, the effectiveness of the radio compass depends fundamentally upon a principle discovered in the early days of wireless telegraphy. That is to say, it was then revealed that the radio waves would set up the liveliest response in an antenna or loop when either of these receiving apparatus lay parallel to the direction in which the oncoming waves were propagated, while, on the other hand, this reaction was found to be weakest when the antenna or loop was set across or at right angles to the arriving radio waves.

Simple as this basic principle is, it has taken years to make the radio compass as reasonably accurate as it now is. One of the difficulties has been to devise ways to neutralize what is termed "re-radiation," emanating from "accidental" antennæ formed by adjacent wire rigging, steel masts, smokestacks, derrick booms, boat davits, ventilators, etc. These have a tendency at times to produce secondary wireless waves of sufficient energy to vitiate the directive influence of the original waves. Today, however, thanks to persistent research and improvement, a wireless compass can be calibrated just as a magnetic compass is compensated to offset the influence of local masses of iron and steel. The experiments of the two Bureaus of the Department of Commerce have made it clear that much can be gained in receptive precision by adopting a fixed wave length for fog-signaling use and then calibrating the radio compass accordingly.

During the World War, the United States Navy did much to develop the practical application of the radio compass, and that arm of the national defense called into being a number of shore stations which it has since operated successfully and helpfully. These radio stations work in groups and are provided with radio compasses with which, on the request of a ship, is determined the position of that craft in the offing. This information is transmitted to the vessel by wireless telegraphy. When two stations cooperate, it is possible, by plotting the directional line from each, to obtain a cross bearing which establishes closely the location of the inquiring navigator. To be effective, the craft must be equipped to send a prescribed signal to the shore stations and then must be able to receive and to translate the response which is in code.

The U. S. Lighthouse Service has sought to develop a system which would function in the reverse order, i.e., permit the mariner to ascertain his position without sending any signals; in short, render it feasible for a vessel carrying only a modest receiving apparatus, and without the aid of a wireless operator, to thread her way confidently through an enveloping fog. This has been achieved by installing at certain lighthouses and on some lightships transmitting apparatus for the propagation of prescribed wireless signals at fixed intervals—the periodicity and character of these serving to identify the dispatching source.

As will be readily appreciated, the radio waves during hours of low visibility are counted upon to perform the same guiding service that the beacons would discharge in dark hours and while the atmosphere is clear. As soon as fog interferes or thick weather obscures the vision of the man on the bridge, the system enables selected lighthouses and light vessels along the coast to send out continuously distinguishing radio signals. The

(Continued on page 105)

THE SCIENTIFIC AMERICAN, August 6, 1921. Volume 125, Number 6. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.
Founded 1845
New York, Saturday, August 6, 1921
Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class matter. Trade Mark Registered in the United States Patent Office.

Copyright 1921 by Scientific American Publishing Co. Great Britain rights reserved. Illustrated articles must not be reproduced without permission.

The Bombing Tests and Our Naval Policy

IF the people of this country and their Congress interpret correctly the results of the recent bombing tests off the Virginia Capes, they will demand the immediate reinsertion in the Navy Bill of the two naval aircraft carriers which were so strongly recommended by the General Board.

The dramatic sinking of the "Ostfriesland," which went down eighteen minutes after a mortal blow was struck by a single bomb, dropped from an Army Martin bomber, does *not* prove that the day of the big battleship has passed. It would be a grave misfortune if this event served to create in the public mind any such belief. As a matter of fact the sinking proved nothing of the kind. The one fact which it did establish was that, if a 2000-pound bomb is detonated at a proper distance below the surface of the water and in close proximity to the submerged portion of an unguarded and helpless battleship, which is ten years old and therefore at the obsolescent stage of her life, she will be sent to the bottom.

Furthermore, there is little doubt among those who witnessed the bombing that, if a bomb of 2000, 1000 or even 600 pounds' weight scores a direct hit upon a ship, great damage will be done to her equipment, particularly to her lighting and electrical and voice-pipe communications, and a large part of her personnel will be disabled by shock.

The one great outstanding lesson is this—that since aerial bombs can work much deadly havoc on a dreadnaught it is imperative that a fleet be provided with every known defensive means for driving off or destroying the enemy bombing machines before they can get within striking distance of the battle line.

There is but one absolutely effective protection of this kind, and that consists in the provision for every fleet of an airplane force, sufficiently powerful to meet the enemy attack and obtain ascendency in the air, early in any fleet engagement. Every capital ship should carry upon its turrets at least two fast fighting or pursuit machines, and two observation and bombing machines capable of being launched by a perfected launching device of the kind which has formed the subject of much experimental work in our Navy. If our fleets are to be in a position where they can obtain mastery of the air, it will be necessary to go further than this and provide for each fleet (one for the Atlantic fleet and one for the Pacific fleet) a large and fast airplane carrier, capable of housing several observation and bombing machines and fast-fighting scouts. To provide the needed carrying capacity, and sufficient width and length of decks for flying off and flying on, these ships should be at least 800 feet in length, and they should have engine power sufficient to enable them to work up quickly to a speed of 32 knots.

We have no such fighting force in our Navy today. Therefore this much at least is certain—that if, tomorrow, our battleships were fighting a line action against an enemy that possessed such an air force as we have just described, he would quickly establish command of the air, and his bombing machines would be free to pass over our lines, where they would be subject to no greater interference than would come from the three-inch anti-aircraft guns on our vessels.

Now, talk with any experienced Navy or Army bombing man, and he will tell you that he cares not a snap of the fingers for so-called anti-aircraft fire. He will tell you that if a plane should be hit it is more a matter of luck than good shooting. In this the statistics of the war fully bear him out. For it took only a little less than 1000 shots to score a damaging hit.

A strong force in the air, with airplane carriers in which they can nest, repair and replenish, is the most crying need of our Navy today. That is the urgent lesson taught by the recent sinking of the German warships off the Virginia Capes.

The Literary Commentator

EVERY language must have its classical literature—though the persistence with which The Vicar of Wakefield retains its place on the list of the College Entrance Examination Board may sometimes cause one to wonder by what test and under what authority the list of classics is compiled. Nevertheless, classics there must be, and careful, detailed study of these classics. The man who makes this sort of thing his lifework has of course a different viewpoint upon such study from that possessed by the man in the street. But even granting this, and allowing the professor of literature all the latitude that is by right his, we wonder whether analysis of the text of the classics is not carried to extremes of absurdity?

Reference to any edition of Shakespeare or Milton that bears the earmarks of conscientious editing will bring to light cases where this question must, at least by any but a classicist, be answered in the affirmative. Much comment will properly be offered on the style, the grammar, the choice of words. The growth of the language will have more or less light thrown upon it by a comparison of the terms and the expressions employed with those current a hundred years sooner or a hundred years later. All this is defensible, and more. It is admittedly interesting to identify the incidents in the life of Goethe which led to this, that, or the other great passage in his works. It is pertinent to show sentences in Shakespeare that reflect the influence of Bacon or of Spencer, or vice versa. It is quite in order to take an obscure metaphor in Milton, and show how it refers to a chain of incidents in the life of a patron or a friend. But the assiduous commentators do not stop here.

When we turn the average classicist loose upon his Cicero or his Shakespeare or his Schiller every word of the original is weighed in the balance with the utmost care against all the possible alternatives which existed, and the precise reason why the author chose the one he did is set forth with learned gusto. We have seen more space and time thus lavished upon the justification of a single Shakespearian conjunction than we would be willing to believe the bard of Avon had used up on the entire scene. We have seen more different accountings for a curious Miltonian turn than the blind poet could possibly have imagined, if he had lain awake o' nights to worry about it. In general, we have seen the classical critics put more heavy thought into word after word, sentence after sentence, passage after passage, than it would have been humanly possible for the original author to have employed in the same place. We have seen them spend much valuable time and use up a vast deal of more or less valuable space in distorting with labored comment what is on its face a casual passage of the original. If this were done merely in the desire to search out the principles of good composition, as unconsciously put into practice by a master, we would have no objection. But the tenor of the commentators' remarks precludes this supposition. He sincerely believes he is reconstructing the master's state of mind.

The classicist, unfortunately, is in sufficient disrepute in this "practical" age to make it quite superfluous for him to pile up absurdities of his own to add to his low standing in the eye of the work-a-day world. Could he not, by some chance, refrain from such studied nonsense as marks so many of his comments on the text of his original? To his fellow classicists they may give the atmosphere of deep erudition; to nobody else do they stand for anything but the sheerest nonsense.

Every Man for Himself

IN the ruthless destruction of our forests and the extravagant and wasteful methods by which we are using up the natural resources of America, we have been following a policy which has been truly described as one in which it is a case of "every man for himself and the Devil take the hindmost."

The most discouraging fact about the whole situation is that, in spite of endless warnings and the carefully prepared governmental statistics showing the rapid depletion of our resources, particularly of our forests, nobody seems to be very much disturbed and the movement to correct this abuse is apparently making very slow headway.

Perhaps in making the above statement we are speaking too broadly; but of this we are certain—that it is impossible to paint in too dark colors and denounce too strongly the ruthless way in which the forests of this country continue to be swept away. Oil and coal once consumed are gone forever, and a mine worked out and an oil field pumped dry have been stricken off the list of the nation's economic assets. Not so, however, with the magnificent forests of this country. For the conditions are such that, by judicious and intelligent replanting, it is possible to make our forests perpetual—so marvelous is the recuperative power of Nature in the matter of the perpetuation of forest growth, if only she be given a chance. If tree planting kept pace with tree cutting, Nature would take care of the balance between demand and supply.

That the thing can be done successfully, and for generation after generation, has been proved in the highly cultivated lands of Europe, where the people seem to be possessed of a forethought and patience that are sadly lacking among the inhabitants of the new world—lacking, at any rate, in this matter of forest preservation. In writing thus, we are not unmindful of the work which is being done by the Government through our Department of Forestry; but if we are to get adequate results, the work of the Department must have the moral backing of the country as a whole. The way in which our forests have been and are still being cut down is an exhibition of a callous and very ugly selfishness. In this matter we must realize that there are duties which we owe to posterity. The forests belong to the people who shall come after us just as much as they do to us, and if we cut them down without provision for their permanent continuance, we are robbing posterity of a priceless possession and a heritage to which they have every moral claim.

In conversation recently with a Persian diplomat in Washington, we asked him whether the district of Persia in which he lived were well wooded. "Not a strip of timber," he said. "Just miles of absolutely barren, sun-baked mountains. Once, these ranges were heavily clothed with timber; but the Persians through the centuries have done what you are doing now in America—cutting down their timber without replenishing it."

Representative Davy, of Ohio, in a recent speech before the House of Representatives, spoke to the same point when he said: "This question of reforestation is of monumental importance. America cannot continue to exist as a virile, forward-moving nation unless we protect what we have and start to build up that which we have so ruthlessly destroyed. We cannot afford to be a nation of Vandals much longer. America must reforest; or she will have to drink the bitter dregs of national decline and impotency."

Sir Robert Hadfield Wins the John Fritz Medal

THE fine catholicity of spirit which has always characterized our American engineers in their award of the John Fritz Medal has been manifested in the award of this distinguished token this year to the well-known British engineer and metallurgist, Sir Robert Hadfield. Sir Robert is perhaps best known to the world at large through the application of his principles to the manufacture of armor-piercing shells, and through his methods for the prevention of segregation and piping in the casting of ingots, both of which have from time to time been described and illustrated in this journal. The John Fritz Medal was formally handed to Sir Robert Hadfield by Mr. Ambrose Swasey, as chairman of a delegation of American engineers who had crossed the Atlantic for the purpose. It is a well deserved recognition of the services he has rendered to engineering practice and industry by the discovery of manganese steel. The Medal is the highest honor American engineers can bestow, and it comes with the full force of the American engineering profession behind it.

Electricity

Liquid Resistance Starters. — Lower in first costs and maintenance costs, liquid resistance starters recently introduced in England are said to possess many advantages over metallic starters. Easily installed, they can be interchanged from one motor to another of a different voltage, with slight alteration to liquid density to suit the new rotor characteristics. No damage is possible through overloading. For certain duties, liquid resistance starters are claimed to be the only practical starters. These starters are totally enclosed, insuring cleanliness and preventing evaporation of the liquid. An easy, gliding starting of the motor is effected without jolts or jerks.

Ontario's Electric Scheme. — After an investigation covering 23,000 farms, it is estimated by the Ontario Government that at least 10,000 farms will install electricity for lighting and power purposes as soon as the necessary transmission lines are provided. It is the intention to construct 1000 miles of these lines during the next five years. The Provincial Hydroelectric Power Commission today is serving about 250 municipalities, operates 13 distinct systems scattered over the province, and distributes 365,000 horsepower of hydroelectric energy. With the early completion of the Queenston-Chippewa plant on the Niagara River, 110,000 horsepower will be available for distribution. With complete equipment installed the plant will have an ultimate capacity of 525,000 horsepower.

An Interesting Electrical Nightlamp has made its appearance in England. It consists essentially of a spiral about 1½ inches long and 1 inch in diameter, which is arranged vertically in a bulb filled with neon gas. Light is produced by a discharge from this spiral in a similar way to the Moore light or mercury vapor lamp, and the resulting illumination is of a beautiful orange color. The rating of the lamp is about 5 watts, and its life is said to be considerably greater than that of the ordinary metal filament lamp. It is supplied for alternating current circuits from 110 volts up, and for direct current circuits from 150 volts up. Lamps of this kind should find a useful application in nurseries, dormitories, hotels, theaters and so on, where a light of low current consumption is required.

The Radio Appeal.—There was a time when wireless telegraphy appealed only to the so-called amateur, and his interest was rather directed toward the technical end than the mere pleasure of gathering messages out of the air for whatever they were worth. With the establishing of Government radio reports and a number of radio telephone broadcasting stations throughout the country, radio reception becomes a matter of considerable interest to everyone, especially persons in remote districts who are ordinarily more or less out-of-touch with the world at large. Today the farmer, the business man in the small village, the camper and others can use a simple receiving set and keep posted on what is going on in commerce, politics, sports, stock and bond market, and even religion.

The Longest Telephone Cable In Existence has been laid between East Prussia and the German mainland, in order to get around the wedge-shaped territory assigned to Poland. This cable has been laid to avoid international difficulties from overland telegraph and telephone lines. It is about 100 miles in length and contains six telephone pairs and three single telegraph wires. Each of the twelve telephone wires is covered with a double layer of annealed iron wire. All conductors are paper-insulated. Owing to the depth reaching some 350 feet at its greatest point, a double lead sheath, a double spiral of steel wire, and finally an outer interlocked steel armoring have been used. Every 1½ miles a water stop has been built into the cable to localize any entrance of water into the cable in case of break.

Getting Along Without Platinum has come to be the rule rather than the exception. With the shutting off of the platinum supplies in Russia, and with the ever-increasing shortage and soaring prices of this precious metal, electrical manufacturers have had to develop ways and means of getting along without it. Fortunately, suitable wires, such as alloys of iron and nickel, and nickel-steel coated with copper, have come to be generally used for the leading in wires of incandescent lamps. Such wires have the same co-efficient of expansion as glass and therefore make a good seal. Heretofore platinum has been used for this purpose; obviously, at the present high prices of platinum each incandescent lamp might have as much as ten cents worth of platinum wire, which would materially add to the cost of such lamps. The use of platinum for contacts has been largely abandoned, either silver or tungsten being used. The latter metal, because of its hardness, is very difficult to work and it is not easy to make a satisfactory point-contact with it.

Astronomy

Meteor Observers in Czecho-Slovakia. — A central office for collecting reports of meteor observations in Czecho-Slovakia was established in May, 1920, at Reichenberg, Bohemia, by Arthur Beer. A noteworthy feature of this undertaking is that 14 branch stations have been established in different parts of the country for the purpose of gathering information regarding casual observations of meteors, as distinguished from those made by regular observers.

Small Clouds on Jupiter.—Prof. W. H. Pickering, in a recent address before the British Astronomical Association, recalled the fact that during his observations at Arequipa he noticed that the surface of Jupiter, instead of being composed of uniform bands of yellowish white or brown, really consisted of an enormous number of extremely minute reddish brown clouds, seen upon a perfectly white background. The effect of belts was produced where the cloudlets were numerous, and the light spaces where they were scarce. He compared the appearance of these spots to the well-known "rice grains" on the sun. Their lengths lay in the direction of rotation of the planet. He said he had since observed the cloudlets in Jamaica, and they have been seen in England by Phillips and Steavenson.

Barometric Effects in Meridian Circle Observations. —As the inclination of planes of equal barometric pressure in the atmosphere varies, there should be a corresponding variation in astronomical refraction, affecting the apparent positions of stars. There has been a good deal of discussion as to the amount of such displacements, especially in connection with meridian circle observations. The subject is discussed in a recent paper by C. C. Wylie, who has examined a large body of astronomical observations for this purpose, and made comparisons with the barometric gradients as scaled from the daily weather maps of the Weather Bureau. He finds "by every method of attack, that the effect of the barometric gradient must be exceedingly small; so small that observers need have no fear of its producing systematic errors in their routine work."

Measurements of Stellar Diameters. — The sensational feat of measuring the diameter of Betelgeuse, accomplished last December at the Mount Wilson observatory with a 20-foot interferometer attached to the 100-inch reflector, has now been duplicated in the case of Arcturus, which was measured by Mr. F. G. Pease with the same apparatus on Feb. 12, 1921. With the mirrors of the interferometer 19 feet apart, the interference fringes were invisible, indicating an angular diameter of 0.024 sec. for the star. From the parallax of Arcturus, which is known with a considerable degree of certainty, the star's diameter is computed to be about 19,000,000 miles. In a recent report on the measurement of Betelgeuse Mr. Pease states that observations made in December indicate the possibility of measuring Alpha Ceti, Alpha Tauri and Beta Geminorum by this process. Concerning Betelgeuse he says the uncertainty of the recent measurement is about 10 per cent. The effect of a possible darkening at the limb, which has been disregarded, would tend to make the measured results too small.

A Remarkable Spectroscopic Binary.—The brighter component of the well-known visual binary Tau Cygni was found to be a spectroscopic binary by Barrett in 1908, but its period was unknown until recently. On the night of July 16, 1920, Dr. J. S. Paraskévopoulos, of the National Observatory of Athens, took a series of photographs of the star's spectrum at the Yerkes Observatory showing that its period is only 3 hours and 25 minutes, the shortest period heretofore found for any spectroscopic binary. By assuming the surface brightness to be the same as the sun's, since it has nearly the same spectral type, the radius of the principal component is found to be larger than the distance between the two components. Neither the hypothesis of a pear-shaped body nor an explanation along the line of the pulsation theory appears to fit this case.

True North by the Stars. — While everyone knows that the Pole Star is not exactly at the north pole of the heavens, everyone does not realize that, in the course of the small circle which it describes about the pole, it is exactly north of us twice every 24 hours. Obviously there must be some other star so situated that when a plumb line cuts it and Polaris the latter is in position to show the true north. Of the easily distinguishable stars, the best for the purpose are Zeta Ursae Majoris and Delta Cassipoeiæ—both of them located below the pole. The American Nautical Almanac, Table VI, page 700, gives full information on this method of determining the true north, including the exact interval of time one must wait, after Polaris comes vertically above one or the other of the stars named, until it occupies a place exactly on the meridian.

Automobile

A New Rust-Proofing Process, which has been successfully used for small automobile parts, has been evolved in a British research laboratory. This consists in boiling the articles to be treated in a solution of hydric-phosphate of iron which produces a dark gray finish practically immune from the attack of rust. It is said to be very much more rapid than Coslettizing and has no effect upon either the strength or temper.

The Municipal Gasoline Hearse.—In Munich, Germany, hearse service has been "communalized" and will be carried out by means of gasoline automobiles exclusively in the future. Heretofore, the service has been partly in the hands of livery men, who furnished horse-drawn hearses and partly of the city which owned a number of electric hearses. The change from electric to gasoline hearses was due to the fact that the electrics were about worn out.

Reclaiming Used Oil. — A new company has been organized in London with the object of reclaiming stale lubricating oil. The waste oil can be bought at prices ranging up to about $100 per ton and in some cases can be had for the cost of collection. It is planned to establish immediately a plant near London with a capacity for treating 50 tons per week, which, it is believed, can be easily collected in London and other plants in the various large cities of the Kingdom.

To Clean Running Boards and Floor. — From the looks of the number of stained and dirty running boards on the cars in use it would seem that few motorists know how to clean them properly. While soap and water will remove the mud and some of the dirt, the running boards will dry with the grease spots and other marks as plain as before. These can be entirely removed and the covering made to look like new simply by wiping them with a clean rag saturated with kerosene. This is also the best way of cleaning the floor boards.

Pre-Heaters An American Feature.—European engineers have not gone nearly so far as we have in the matter of applying heat to the incoming charge, from descriptions of European cars that have recently reached us. This may be in part accounted for by the fact that none of the large European industrial countries has the low winter temperatures that we have to contend with but the chief reason undoubtedly is that the gasoline sold in Europe at the present time does not have the low end point that ours has, and vaporizes at lower temperatures.

Narrower V-type Engines.—Lancia, the automobile manufacturer of Italy, has evolved a construction, recently patented in England, by which the width of V-type engines is decreased. In a twelve cylinder engine, for instance, the axes of the two sets of cylinders do not meet at the center of the crankshaft but a distance below the crankshaft about equal to the length of the connecting rod. The axes of the connecting rods at dead centers make an angle of 20 degrees and the cranks of each pair of cylinders make an angle of 40 degrees. In this way it is hoped to obtain a fairly good balance.

Better Seated Bonnets.—A recently devised engine-bonnet lock of the eccentric type is claimed to permit of the use of a much stronger spring than is used on the present type of lock and still be readily operated with one finger. The eccentric locking element is associated with the bonnet catch in such a way that a two-point bearing of the same is secured, the intention being to prevent rattling and side motion of the bonnet. The bonnet lock is adjusted by rotating the body on the anchor bolt. This lengthens or shortens the lock, as desired. Each time the lock is released the anchor bolt is automatically forced into engagement with an absorbent-oil-saturated pad, contained within the lock body. This lubricates all moving parts.

Natural Gas Gasoline.—By the addition of the highly volatile natural-gas gasoline it is possible to make use of the gasolines of low volatility in even cold weather. The failure of natural gas through Ohio and Pennsylvania which are the two leading natural-gas states, is of course going to have a similar effect on the natural-gas gasoline industry. An authority has pointed out the ever-increasing use of the absorption methods of manufacturing natural-gas gasoline. This, he stated, is a result of experiments during the war on the high absorption qualities of charcoal. This development is going ahead very rapidly and plants using it are running at 50 to 75 per cent efficiency, which is higher than by previous methods. It is also found possible by this method to extract the gasoline from natural gases which are very lean in gasoline and from which it is practically impossible to get results with the compression method which was previously used.

Depth-Bombing from the Air

Results and Lessons of the Sinking of the "Frankfurt" and "Ostfriesland" Off the Virginia Coast

THE United States Navy is to be congratulated upon the success which attended the recent elaborate air-bombing tests, extending over a period of several weeks, in the course of which several submarines and destroyers, a modern scout cruiser, and a 22,000-ton dreadnaught were sent to the bottom. These ships were allocated to the United States as our share of that portion of the surrendered German fleet which was not sunk at Scapa Flow or was salvaged subsequently to that sinking. These ships were allocated with the understanding that they were to be completely destroyed before the close of August, 1921. The Navy decided that they would destroy them under conditions which would simulate, to some extent, the conditions of actual warfare. The plan of operations contemplated first, an attempt to destroy the ships by bombing from the air, and secondly, should the bombing fail to put them down, an attack by gun-fire. Should both of these efforts fail in the case of any ship, a wrecking crew was to be sent aboard and the vessel was to be sunk by high explosives placed within her hull.

"Ostfriesland" sinking; quarterdeck submerged; heavy list to port

Many months ago, when these plans were formulated and before the discussion as to the relative value of bombing planes and battleships had grown to its present dimensions, the Navy Department, in a fine spirit of cooperation with the Army, requested the Army Air Forces to join them in these bombing attacks. We wish to take this opportunity to contradict the popular impression, which unfortunately the daily press has done so much to develop, that there was any spirit of rivalry or fierce competition between the two forces. As a matter of fact, the Army greatly appreciated the opportunity thus presented, and the cooperation between the two was marked by good sportsmanship and perfect military coordination.

Direct hit on "Frankfurt"; note splash of fragments

Conditions Were Highly Favorable for the Attack

If we wish to get a true perspective of these experiments, we must bear in mind and it should be emphasized at the very outset, that the conditions under which the bombing was carried out were purposely made as favorable as possible for the attack. It should be understood that never again, except in the event of extreme carelessness and neglect, will any airplane force be able to fly, at its own chosen height and in its own chosen weather, across a fleet of anchored ships which has no defense whatever against the enemy. If you were to ask any of the bombers of the attacking air force he would bear out the above statement and tell you that from his point of view he had every possible condition in his favor.

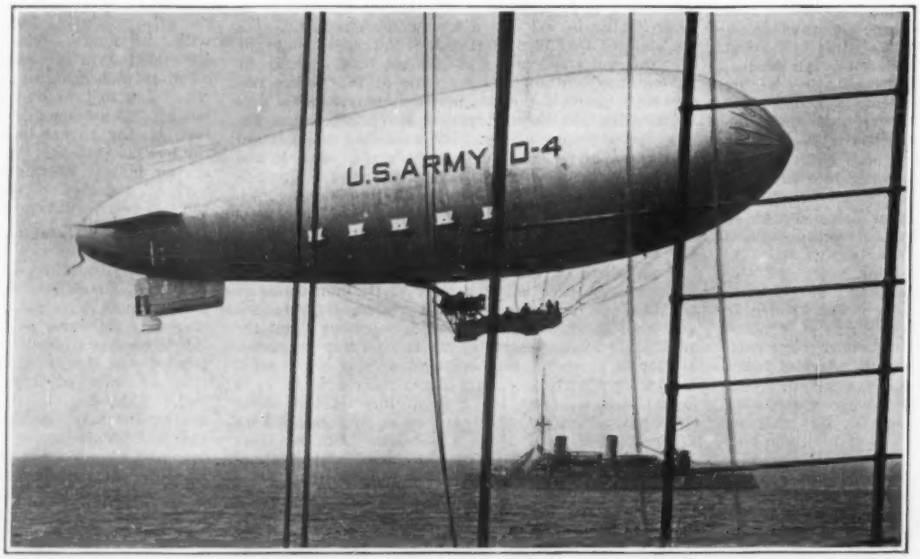
To particularize, we may mention, first, that the most successful approach to the target is one that is made with the target dead to windward, and in every case during the three days that we were witnesses of the bombing, the attack was made up the wind. In an actual engagement such freedom of choice would not be possible.

Secondly, each flight of planes was permitted to pass over the target and withhold its bombs, if the captain did not consider that the position was ideal for releasing the bombs; in fact, a flight would sometimes pass two or three times across the target before it had made the necessary corrections and considered itself in the best possible position. This, of course, would be impossible in actual battle, where the opposing enemy craft would be in the air and a barrage of anti-aircraft shrapnel would be built up against the attack.

Thirdly, the attacks were made only in favorable weather. Low-lying clouds, a heavy haze and the approach of twilight were sufficient to call off the operations. In wartime, of course, the attacking force would have to take its chances of adverse wind and weather and poor visibility.

Fourthly, the targets were anchored—a point of immense advantage to the bomber, when using his sights from the plane above. In an actual fight battleships would be moving from 17 to 25 knots an hour, cruisers from 25 to 35 knots, and the quick helm, which characterizes all modern warships, would enable a ship to make a change of course as soon as she saw the bombs let loose by the enemy. Zigzagging may well prove to be one of the most effective defenses against aircraft bombs, particularly against those which are launched from high altitudes.

Lastly, there were no opposing craft in the air. The fast fighting scout is master of the heavy bombing machine and, unless the latter is protected by her own scouts she will be sent down before reaching the target.



The old and the new. A blimp, out for bombing observation, and below, Admiral Dewey's flagship "Olympia," 30 years old, still in commission and capable of 18 knots

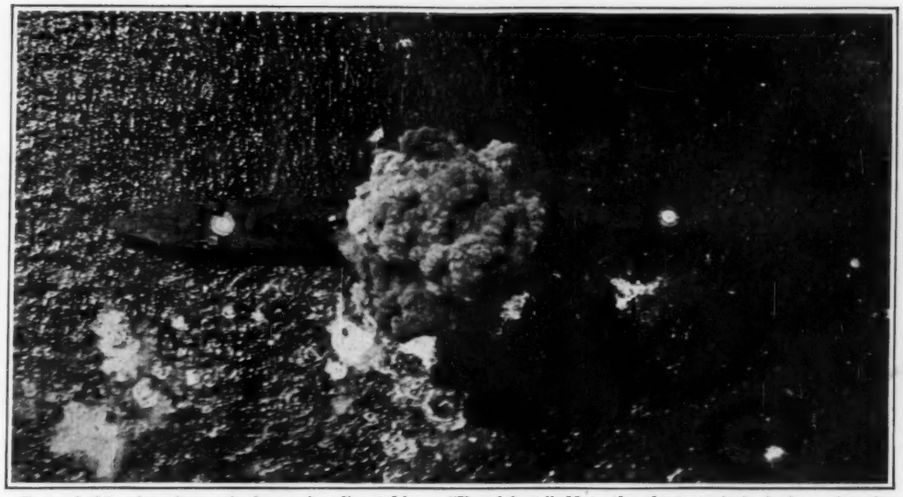
High Percentage of Hits by the Bombs

Having cleared the air by the above statement of the favorable conditions under which the attacks were made, we hasten to state that the work done against the "Frankfurt" and "Ostfriesland" was excellent. The Army and Navy bombers are to be congratulated. Due largely to the fact that they were working off an old stock of English bombs, a large percentage of the Navy shots proved to be "duds," and consequently their work did not make such a dramatic showing as that of their confreres of the Army. We remember one Navy flight which let fall half-a-dozen bombs that formed a beautiful pattern around and on the "Frankfurt"; but not one of these bombs detonated. Without having the exact figures at hand, we think it is safe to say that fully 50 per cent of the bombs either made direct hits upon the target or dropped sufficiently near to have a damaging effect upon the submerged hull of the ships. When we remember that air bombing is, even today, a comparatively new art, and that the sighting instruments are considered to be in the experimental stage, we feel justified in predicting that before many years have passed, bombing from the air, even at much greater altitudes than the 1500 to 1700 feet employed in the recent tests, will take on something of the accuracy of gun-fire. It should be remembered, furthermore, that about the last man to play safe in warfare is your air pilot. After seeing a single 2000-pound bomb crushing in the underbody of a battleship as though it were an eggshell, it is certain that under the stimulus of a great battle, upon which the fate of a nation depends, there will be found many an airman who will not hesitate to dive down at 200 miles an hour, until he is within point-blank range, and place his bomb in just the right position alongside the enemy to sink him, and sink him quickly.

Direct Hits More Destructive to Personnel Than to Ship

During the tests of July 18th against the "Frankfurt," which we witnessed from aboard the battleship "North Dakota," at a distance of 1800 yards from the target, it was clearly demonstrated that however much destruction bombs of 250 to 600 pounds' weight might work if they made direct hits upon the ship, they would not suffice to sink her. It was easy to determine a direct hit from one alongside the ship. In the former case there would be an enormous burst of dark-brown smoke, centered in which would be a huge

splotch of red flame 50 feet in diameter in the case of the larger bombs, which would be followed a few seconds later by the snappy, snarling report which is characteristic of high explosives. Sometimes, at the burst, the surrounding water would be flecked with the splash of fragments of shell and the shattered woodwork of the ship's decks. More often, when the smoke had cleared away, it would be impossible to detect any material damage, even through the most powerful glasses. The most dramatic hit and the one with immediately visible results was made by a 600-pound bomb which passed through the super-structure deck of the "Frankfurt," amidship, and by the force of its explosion lifted the deck and bent it over the side of the ship. As we looked at this through the glass, our thoughts went back immediately to the sinking of the "Maine" and to the remarkable way in which the foredeck was lifted up and curled back upon the super-structure in the great explosion at Havana. The bombs failed to penetrate the protective deck of the "Frankfurt," and apparently did no great harm to the shell plating of the ship above water. They failed to start any serious leaks during the first several hours of bombing, and this in spite of the fact that the later bombs dropped were of 600-pound weight. So well did the cruiser stand up under this attack that it began to seem doubtful whether she would be sent down before the day was over. The fatal blow was delivered on the starboard bow and not far from the ship's hull. The detonation was heavy, the hammer blow of it being felt through the water by our ship which at the time was over 2000 yards' distant. There was a big upheaval of water which fell mainly across the ship, and when it had drained off, it was seen that the bow was steadily settling and the stern rising above its normal flotation mark. Twenty minutes after the fatal bomb had crushed in the side of the "Frankfurt," she disappeared.



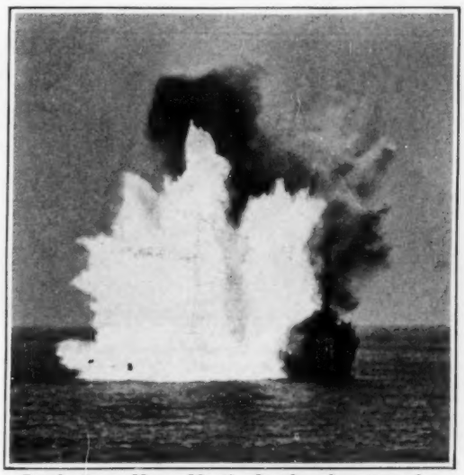
Remarkable view from airplane of a direct hit on "Frankfurt." Note the characteristic dark smoke of a hit and the splash of scattered fragments, blown from the upper works of ship

Sinking of the Dreadnaught "Ostfriesland"

The program of the attack upon the dreadnaught "Ostfriesland" called for bombing first with 300-pound and then with 600-pound bombs. If these failed to sink the ship, she was to be bombed with 1000-pound bombs. If she were still afloat, an attack with a specified number of 2000-pound bombs was to be made. If she survived these, the "Pennsylvania," flagship of the Atlantic Fleet, was to try to put her under with salvos of 14-inch shells at a distance of not less than 18,000 yards or nine nautical miles. If the resistance of the ship was equal even to this final test, a squad from the "North Dakota" was to go aboard, place large charges of TNT on her bottom and sink her. The confidence in the modern system of anti-torpedo and anti-mine internal construction was such that there were a large number of officers and men of the fleet who believed that, battered as she might be in her upper works the "Ostfriesland" would succumb only to the well-placed salvos of the "Pennsylvania."

The "Ostfriesland" a Well-Protected Ship

To get the full significance of the sudden destruction of the "Ostfriesland," it should be clearly understood that in respect to internal subdivision she was a well-protected ship, completed in 1911. Since the surrender to the German fleet, expert officers of the British and our own navies have made a thorough examination of German battleship construction, and it is agreed that in underwater subdivision as a protection against mine and torpedo, the Germans were somewhat ahead of contemporary ships. The "Ostfriesland" is by no means out of date, as may be judged from the fact that she was a contemporary with the latest of the British 12-gun and the earliest of the British 13.5-gun dreadnaughts, and also with our own dreadnaughts "Utah," "Florida," "Arkansas" and "Wyoming." Within her outer shell she had longitudinal bulkheads, including one armored bulkhead of a tough, ductile steel, designed to bend without breaking under the impact of high explosives. Such at least was the design, and as far as we know she was built accordingly. At any rate, the "Ostfriesland" has it to her credit that in the flight back to Germany after the battle of Jutland, she struck a mine and nevertheless reached port under her own power. A sister ship is credited with having received during the same battle the blow of four 15-inch British shells, in addition to being twice torpedoed. This vessel also reached port. An important feature in her construction, which is of great importance in considering the quick sinking of the vessel, is that her bulkheads were not pierced by watertight doors; in other words, communication from compartment to compartment was "up and over." It is the consideration of these facts which leads us to believe that the 2000-pound bomb which was detonated a few feet from her port quarter must have opened up a section of the underbody of the ship far greater than would have been blown in by the detonation of a torpedo or a mine.



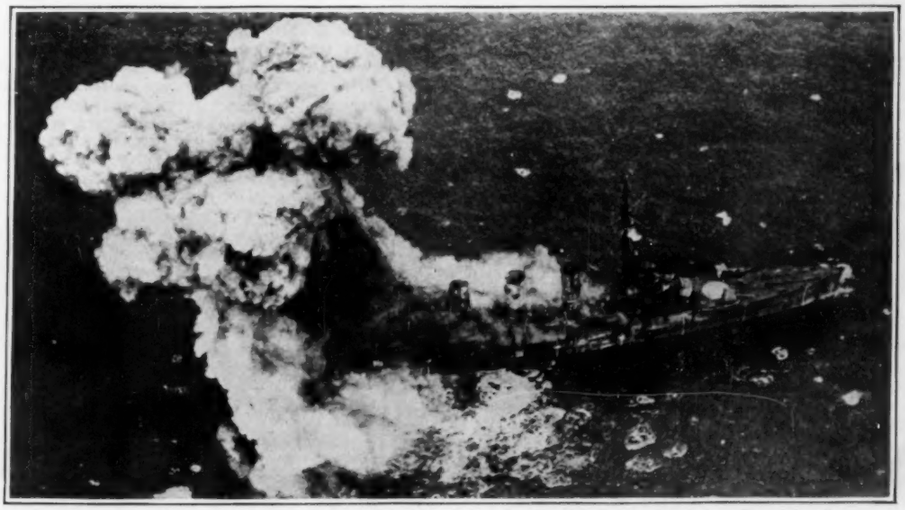
Bomb from Navy Martin bomber bursts under water near starboard bow of "Frankfurt"

How She Went Down

The bombing of the "Ostfriesland" was set for Wednesday and Thursday, the 20th and 21st of July. Due to unfavorable weather conditions, the first attack did not start until noon. It was carried out with 600-pound bombs which were well placed, some of them aboard and some not far from the ship. After two direct hits, the destroyer "Harding," from which we observed the test, steamed in alongside the "Ostfriesland," and even from the distance of 100 yards, it was impossible to note any external effects from these explosions. They had penetrated the upper decks and burst above the protective deck—which, of course, they failed to affect. On reaching the scene of operations on the morning of the 21st, it was noticed that the "Ostfriesland" was about two feet down at the stern, and it was evident that a slow leak had been developed by the bombing of the previous afternoon. During the early morning of the 21st, attacks were made by five Army Martin bombers, which dropped 1000-pound bombs. These failed to make any appreciable difference in the submersion of the ship. It had been intended to try the penetrative effect of 14-inch naval shells dropped from naval bombers, but, due to a change of program, five Martin bombers and a Handley-Page machine came out from Langley Field carrying 2000-pound bombs. Orders had been given to endeavor to place these outside of the ship and as near to her hull as possible. The work of destruction is believed to have been done by two of these half-dozen bombs—namely the fourth and fifth. One of these landed close in on the port side of the vessel, not far aft of amidships, and the second close in on the port side of the stern.

The destroyer "Harding" was about two miles' distant from the stern and directly in line with the longitudinal axis of the ship. The delayed-action fuse of the second bomb must have worked admirably and have burst the bomb well down below the surface; for it lifted and dropped upon the ship an enormous quantity of water, which, from our point of observation, completely hid the vessel from sight. As the finer mist disappeared we noticed that a perfect Niagara of solid water was pouring down from the bridge, the conning tower, the after turret and the quarterdeck. When this

(*Continued on page 105*)



Note how this bomb has thrown great masses of water across the decks of the "Frankfurt"

Dead Men's Fingers

One of the Most Interesting Groups of Our Less Common Fungous Growths

By Dr. William Alphonso Murrill, New York Botanical Garden

ONE of the summer boarders insisted that it was a dead rat; another favored a leak in one of the sewer pipes as explanation. The mycologist of the party investigated beneath the house and soon emerged triumphant bearing aloft a magnificent specimen of the veiled stinkhorn. After he had explained how the green, slimy cap, borne on the white stem, was attractive to flies because of its odor, which developed only after the spores were mature and ready for distribution, all became interested; and it was one lady's opinion that the odor, like that of the skunk, was "strong but not particularly disagreeable." From time immemorial, man has dreaded the unknown and greatly exaggerated what he has not understood!

The stinkhorns, or "dead men's fingers," as they are sometimes called, occur during the summer and fall about buildings, in cultivated grounds, or on the ground in woods; and most of them make their presence known by a powerful fetid odor. The underground mycelium, or spawn, consists of cord-like strands matted together, to which are attached rounded, pink or white "eggs," and from these arise at the proper season conspicuous stalks bearing at their apex the spores and the malodorous slime so attractive to blow-flies, green-flies, carrion-beetles, etc.

If one of these "eggs" is cut open, all the parts of the mature fruit-body may be seen in embryo compactly tucked away in its various layers. Between the thin inner and outer coats is a thick gelatinous layer, which is traversed by a central column surrounded by a dark green substance. If a fully grown "egg" is kept warm and moist, it will soon develop, and the various stages may be watched. The central column is composed at this early stage of cells closely compressed together, which absorb water and expand very rapidly, breaking through the roof of the "egg" and leaving its "shell" as a cup, or volva, at the base of the elongated stalk.

This expansion usually takes place at night and is so very rapid that the movement actually becomes visible. The dark green mass, borne aloft on the stalk, melts to a slimy fluid containing minute, ellipsoidal spores; while a fetid odor is generated and borne on the breezes to all the flies in the neighborhood, advertising the fact that a banquet is prepared for them in exchange for their assistance in distributing the spores.

The stinkhorns, or phalloids, are remarkable for their peculiar and interesting forms, their attractive coloring, and their fugitive occurrence. About one hundred species are recognized, widely distributed throughout temperate and tropical regions, but many are imperfectly known. Of the commoner American species that are provided with conspicuous stalks and possess the well-known disagreeable odor, perhaps the commonest is the veiled stinkhorn, or *Dictyophora duplicata*. The cap is bell-shaped, 5 centimeters long, the surface appearing strongly reticulate-pitted after the fetid, olivaceous gleba has been devoured by flies or washed away by rains; apex truncate, perforate; spores oblong-ellipsoid involved in mucus at maturity; stem fusiform-cylindric, tapering at each end, cellular-spongy, white, hollow, 10-20 centimeters high, 2.5-3 centimeters thick; veil white, reticulate, variable in length, sometimes much expanded, always conspicuous, fragile; egg globose, nearly white, frequently pinkish, 5-7 centimeters in diameter.

This very conspicuous and objectionable species occurs in the United States about buildings and near stumps in fields and in the edges of woods. It may be easily recognized by its conspicuous veil, which is attached near the apex beneath the cap and hangs down to the middle of the stem or lower. There are few finer examples of natural lace-work than this delicate white veil. The mature fruiting surface, or gleba, is extremely fetid, proving attractive to flies, which disseminate the spores. The stinkhorns have usually been considered poisonous, although little experimenting has been done in the group on account of their odor. According to McIlvaine, the eggs are tender and excellent for food when cut in slices and fried or stewed. I have found the veiled stinkhorn frequently from midsummer to fall in New England and southward to North Carolina and Tennessee. Fully grown eggs when brought into the house will usually develop mature plants in a single night.

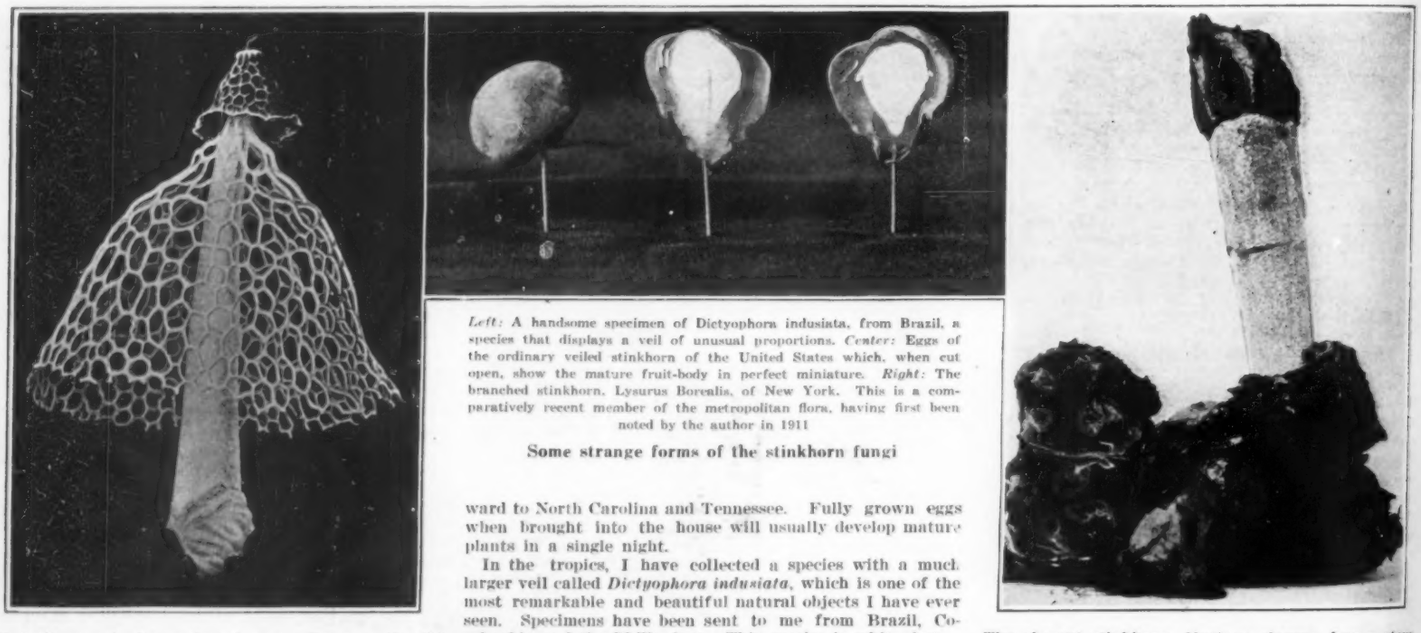
In the tropics, I have collected a species with a much larger veil called *Dictyophora indusiata*, which is one of the most remarkable and beautiful natural objects I have ever seen. Specimens have been sent to me from Brazil, Colombia and the Philippines. This species is white, but there is another in the tropics and in the southern United States which is red all over and has no veil. In Hawaii the red species attack the roots of sugar-cane, causing an average loss of about ten per cent of the crop. Its development from the egg has been carefully traced, showing that in the later stages the stalk elongates as much as an inch and a half in a single minute!

In the sawdust stinkhorn, *Dictyophora Ravenelii*, the cap is conic-bell-shaped, 2.5-3.5 centimeters long, the surface white and granulate or minutely wrinkled after the disappearance of the olivaceous gleba; apex smooth, white, umbilicate, closed by a thin membrane or at length perforate; spores oblong-ellipsoid, involved in mucus; stem cylindric, slender, tapering at each end, cellular-spongy, white, hollow, 10-12 centimeters high, 2 centimeters thick; veil membranous, usually scarcely half the length of the cap and concealed beneath it, very rarely protruding; egg ovoid, pinkish, 4-5 centimeters in diameter, containing the lower half of the veil attached about the base of the stem.

This species occurs in abundance in old sawdust piles and about rotting logs and stumps in woods and fields in the eastern United States and Canada. It may be readily distinguished from the veiled stinkhorn by the absence of a conspicuous, reticulate veil; its cap is smooth instead of coarsely pitted; and its odor is less penetrating and disagreeable. The veil is a very thin, delicate membrane, which is usually concealed beneath the cap and therefore not noticed.

I have specimens from Canada and most of the eastern states and have found them at times in great abundance. One autumn at Ithaca I discovered a bed in an old sawdust pile from which I brought in eggs and mature plants by the basketful. At a certain stage of development we found it exceedingly difficult to obtain photographs that were not blurred by the movement of the stalks.

The common stinkhorn of Europe, *Ithyphallus impudicus*, looks very much like the sawdust stinkhorn, but has no veil of any kind and its cap is coarsely reticulate like that of the veiled stinkhorn. A pink variety is said to occur in the southern United States, but I have seen no typical specimens except in Europe, where it is fully as abundant and offensive as is our veiled stinkhorn in the eastern United States. A gentleman in France freed his grove of this species by removing the soil for a foot or more at every spot where the fungus occurred and filling the cavities with quick-lime. This method should be applicable about houses and on lawns for any species of the group. A destructive root-rot of the grape is attributed to the common stinkhorn in some parts of Europe.



Left: A handsome specimen of Dictyophora indusiata, from Brazil, a species that displays a veil of unusual proportions. *Center:* Eggs of the ordinary veiled stinkhorn of the United States which, when cut open, show the mature fruit-body in perfect miniature. *Right:* The branched stinkhorn, Lysurus Borealis, of New York. This is a comparatively recent member of the metropolitan flora, having first been noted by the author in 1911

Some strange forms of the stinkhorn fungi

The elegant stinkhorn, *Mutinus elegans*, has a stem horn-shaped, cylindric, tapering gradually to the apex, pitted, hollow, white or pinkish below, bright-red or orange above, 10-17 centimeters long, about 2 centimeters thick; apex conic-acuminate, perforate; gleba greenish-brown, semi-fluid, fetid, smeared over the upper portion of the stem in an indefinite manner; spores oblong-ellipsoid; veil none; egg oblong-ovoid, pinkish, 2.5-3 centimeters long.

This species is very conspicuous by reason of its size and brilliant red or orange color. Its odor is sickening and penetrating, but not so strong as that of the veiled stinkhorn. It occurs quite commonly in the United States in woods or in cultivated ground rich in decayed vegetable matter. I have specimens from most of the eastern states and have collected it at several places in New York, Pennsylvania, Virginia, and Tennessee, usually in woods or near trees. At Ohio Pyle, Pennsylvania, I found it abundant about an old stump beneath a porch, where the fruit-bodies appeared daily for some time. Excellent specimens were also obtained from a tub in one of the greenhouses at the New York Botanical Garden. The eggs are curious objects, especially in section. According to McIlvaine, they are edible when sliced and fried.

Another American species, *Mutinus Ravenelii*, is

(*Continued on page 107*)

Copyright, Keystone View Co.

Two views of a travelling and floating store which stops at various towns and villages along the St. Lawrence River

Moving Houses to Clear the Mines

HIBBING, Minnesota, called "the richest village in the world," is going through a novel experience. A part of this prosperous town in the iron range is being moved. Hibbing is one of the new towns which have sprung up since ore was discovered, and it is really a sort of "industrial romance" made practical. It is not literally a fact that the whole of Hibbing is being moved, but people talk that way. Sixteen blocks of the original part of Hibbing, overlay a valuable "40" of land which it is desired to exploit; and as this town has never failed to grasp opportunities, this one-third of the village is being cleared of buildings so that mining companies can have access to the valuable deposits. In place of this cleared away section, a new part of the village will be reared on the outskirts.

Because of the number and the size of some of the buildings to be moved, this activity has called for the highest skill on the part of the home movers. Steam locomotive tractors, equipped with traction belts, have been largely used, together with the usual jacks and heavy trucks, logs, etc., as shown in our cover illustration.

It is almost impossible to estimate the many millions which will be needed to tear down and rebuild such a large area, but Hibbing feels it is making history; and so all classes of labor, the mining companies and citizens, are working side by side to accomplish results. It seems an almost superhuman achievement, but in the end another city will rise as the result of a new kind of town building and the exercise of a community spirit which is working for the good of all. In a short time there will be one continuous Hibbing entirely different from the original village, but a witness of the heroic work done in the iron ranges.

As a matter of fact, the ranges, on one of which Hibbing is located, furnish three-fifths of the millions of tons of ore which the United States contributes to the world. All this is a part of the development of the past fifty years, and the army of employees necessary to work this ore is a vast one. It is estimated there are 125,000 men working on these ranges in Minnesota alone, and the industry creates a certain atmosphere, and makes town, railroads and immense lake traffic.

The number and nationalities of foreigners employed is a revelation to one who visits the ranges for the first time. Perhaps no activity in this country can furnish such a diversity of nationalities. Canadians, English, Scotch, Hollanders, Bulgarians, Montenegrins, French, Norwegians, Belgians, Germans, Swiss, Finns, Russians, Swedes, Danes and others are found in various occupations. Many have gone directly to the mines on landing in this country. Others have lived in the United States for a number of years. Skilled and unskilled, they are important factors in the development of the range. First came the Scandinavians, Finns and Austrians to help dig Lake Superior ore, and following some time later were the races of Southern Europe—from Serbia, Montenegro, Bulgaria and Croatia.

These workers are young or middle aged, and their children attend schools which are up-to-date and of a standing far ahead of those of the countries from whence these people came. Hibbing recently erected a grade building at an expense of one hundred and twenty-five thousand dollars. The range towns are interested in all outside matters. They have a free, generous spirit—a sort of "spirit of the range," which comes from familiarity with colossal movements that are taking place daily. Great ore pits, heavy cars loaded with rapidity and speed, the latest improvements in machinery—these are features of this stupendous business. Nowhere else in the world is it possible to uncover a bed of ore which stretches for mile after mile, and to mine it in places as if it were sand by means of steam shovels, locomotives and trains of cars.

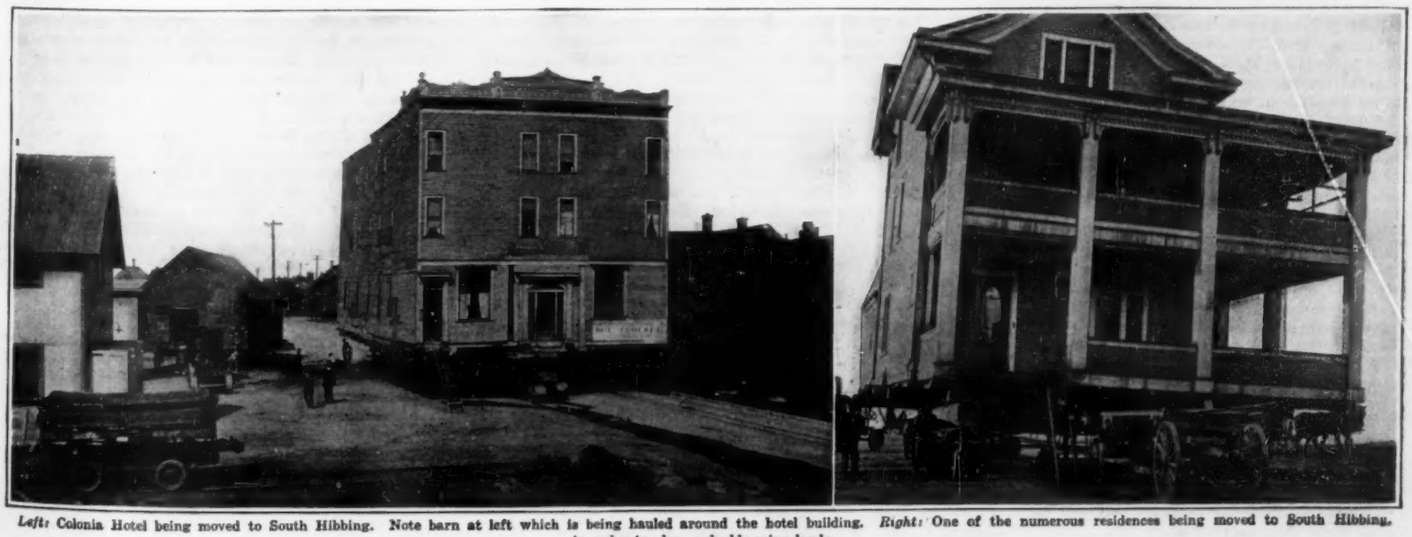
An interesting feature in connection with the ore mines of Minnesota is that many of them are owned by the State; in fact, every year the permanent school, university and trust funds receive from this source by way of royalties about seven million dollars.

Business As Usual Aboard Ship

WHETHER it is to escape high rents and high taxes, or to be able to shift one's location at will, the fact remains that business has followed in those footsteps of many families which lead to the houseboat. In many different parts of the country we find all kinds of business being done aboard ship and apparently with excellent results.

In the heart of New York City, for instance, there are some nine houseboats one and two stories in height, moored to a dock in the shadow of one of the huge East River bridges. These houseboats serve as the quarters for as many fish and seafood dealers, whose wares come direct to their backdoor when the fishermen pull up every day. In the outskirts of New York City there is a hardware and ship chandler establishment which thrives far out in the bay, aboard a houseboat. There are many refreshment stands and other similar establishments which find it the part of good business to operate aboard ship rather than on good old *terra firma*.

Most unique, perhaps, is the travelling store idea, of which the accompanying illustrations convey an excellent pictorial description. This particular establishment has travelled over the St. Lawrence River for several years, and it is said that wherever it stops, the trade is sure to be flourishing. Not only do the inhabitants of the towns and villages find rare bargains among the offerings of this travelling store, but they also take this opportunity of stocking up on numerous articles of food, wearing apparel, household utensils, and so on. The line of goods carried in this floating store ranges from a feather for Milady's hat, to canned cherries for dessert, most of the stock having been bought at auction or at receiver's sales in order to reduce the selling prices. Residents of the rural districts of the east whose memories extend back will recall the peripatetic peddler, who came through the country-side at intervals with his miniature department store on his horse-drawn cart. Where water transportation is good, why not have the water-borne peddler?



Left: **Colonia Hotel being moved to South Hibbing. Note barn at left which is being hauled around the hotel building.** ***Right:*** **One of the numerous residences being moved to South Hibbing, in order to clear valuable mine lands**

Two views which, in conjunction with the cover illustration, furnish an excellent idea of Hibbing's house-moving activities

Where Oil Occurs

A Brief Description of the Rocks and Sands in Which Petroleum Is Found

By C. H. Messerly

EXPERIENCE has taught us that oil does exist, and that it is found in formations or reservoir rocks known as sand, sandstone, limestone, etc., and that commercial deposits generally occur in the higher parts of folds of the earth's surface, called anticlines, domes, monoclines, etc. Water is generally found in the same stratum as the oil, but in the lower part of the fold. Oil, being lighter, is found next above, and gas, being still lighter, in the top. Some authorities say that oil is generated in underlying strata and has migrated through the different formations and crevices to these reservoirs, which are capped or covered by practically impervious beds of shale, sandstone or limestone, most frequently shale. The action of this cap rock is to prevent the oil from leaking away to the surface and disappearing. This is what must have happened in some fields from which the oil has vanished.

One of the most widespread formations overlying gas and oil sands is the Utica shale above the Trenton limestone in the Ohio and Indiana fields. The Clinton sand of central Ohio is overlaid by the Clinton shale. The oil sands of Pennsylvania and West Virginia are all overlaid by impervious shales. In Louisiana fields a hard stratum of limestone sometimes acts as a cap rock overlying a more pervious portion of the same formation.

The porosity or capability of sandstone and sands to hold oil is due to the shape and arrangement of the grains. In the case of sandstones, the occurrence of oil is due not only to structure, but is affected also by the continuity of the stratum. Drillers recognize the internal variations when they speak of a sand being open or close, soft or hard and good or poor in character. The question of the amount of oil which a certain formation can contain in view of its porosity is a rather complicated subject. The texture of the sand is of supreme importance. Sandstones and shales often carry oil, but they are not the most favorable reservoirs, since in most sandstones the cementing material binding the sand grains together fills the pores so that the rock can hold only a small quantity of fluid.

The percentage of voids in the various kinds of strata varies considerably. Sands may contain from 15 to 35 per cent voids; sandstones 5 to 15 per cent; conglomerates as high as 30 per cent; shales from 2 to 10 per cent; and some dolomitic limestones are reported to contain as high as 35 per cent. The percentages are so variable that one cannot take the material in one field to be a criterion or measure of material in other fields.

The quantity of oil in sands depends on the percentage of voids in the sand and its saturation, by which is meant the percentage of oil present by volume in a cubic foot of sand. We are told that some sands contain 20 per cent voids, and if those voids were full, the saturation would be 20 per cent, hence 100 cubic feet of sand would contain 20 cubic feet of oil. The United States Government, in its estimates of oil reserves, takes 10 per cent as the saturation. For example: A bed 100 feet thick and covering an acre of land would contain (42 gallons per barrel—7.5 gallons per cubic foot) 77,786 barrels. It is estimated that the porosity of the Appalachian field is 12.5 per cent; of the Illinois and Mid-Continent field 17.5 per cent, and of the California field 25 per cent.

It is a well-known fact that the quality of crude petroleum is determined by the impurities contained therein. As an illustration it may be cited that Lima, Ohio, oil contains about .75 per cent sulfur and that Pennsylvania oil contains only about .03 per cent. Because of these impurities and the greater cost of refining, the price also varies.

I cannot find any scientific theory for the fact that more impurities are contained in the oils of some fields than in others, but it is possible these may have been picked up in its migratory process, rather than from the sand where the oil happens to be found.

The specific gravities of petroleum have also been used as rough measurements of its value. The lighter the oil, the better it is generally considered. An oil with a specific gravity of 40 degrees will generally produce more of the valuable by-products than one of 15 degrees.

One author says the difference in specific gravity is due to migration, or travel from one formation to another. Another that it is due to age, the heavier oils occurring in formations that are much younger than those containing lighter oils, although it is stated there are exceptions to this rule.

In conclusion, or as your parson would say, "Lastly," it might be of interest to group the oil pools of the United States into fields. The most important of these are the Appalachian, Lima-Indiana, Illinois, Mid-Continent, Gulf Coast, California, Colorado and Wyoming.

The Appalachian field covers a very large area, but it is no longer the most important in quantity of production, although it continues to hold first place in quality. It embraces all oil pools east of central Ohio, including New York, Pennsylvania, West Virginia, southeastern Ohio, Kentucky and Tennessee. With the exception of that from Kentucky and Tennessee most of this oil is considered Pennsylvania grade, free from objectionable sulfur and from asphalt, and rich in paraffin.

The Lima-Indiana field comprises Western Ohio and Indiana. The petroleum in this field was found in the Trenton limestone, contains little asphalt but is contaminated with the objectionable sulfur compounds.

The Illinois field is located in the state bearing its name, the main portion of which is associated with a structural feature known as the La Salle anticline, extending from the northeastern part of the state into southwestern Indiana. The petroleum is thick, asphaltic, and contains sulfur in the northern portion, but in the southern part of the field it is found at a greater depth, is thinner and contains little or no sulfur. The Mid-Continent field includes the oil pools of Kansas, Oklahoma, Caddo, De Soto, Louisiana, and northern Texas. The petroleums of this field vary in composition within wide limits. Most of the Kansas oils are asphaltic, but in Oklahoma petroleum of both paraffin and asphalt base are found. The crude petroleum of the Healdton field in Oklahoma is of lower grade than the crude oils from the Glenn pool and Cushing field on account of the lower gasoline content and the large percentage of sulfur present. In northern Louisiana and Texas paraffin base petroleums, free from sulfur, predominate, but asphaltic oils of higher gravity have also been found.

In the Gulf Coast are included a number of areas lying in the coastal plain region, the pools of southern Texas and southern Louisiana. The oils have been found in association with salt domes, which also carry limestone and gypsum. They are usually heavy, asphaltic and sulfurous, but occasionally lighter, nonasphaltic ones also occur.

In the California field the petroleums have been usually characterized by much asphalt, although in recent years lighter oils have been found.

In the Colorado field a high-grade, light illuminating oil is found in Boulder County, a lubricating oil in Routt County, etc.

The Wyoming field is one of the newest, the oil in Big Horn County being a heavy, black asphaltum oil. In other places oil of a paraffin base and higher gravity has been found.

Although new producing formations are constantly being developed, in almost every oil field of any size or age there has been found one or more sand strata that stand out prominently because of the thickness of their "pay streaks" and producing qualities: these strata are used for purposes of comparison, values being frequently based upon their past history and production per acre over a given period of time. In the eastern oil fields we find the second and third sands of Oil Creek, Pennsylvania; the second, Tioga and Bradford sands of northwestern Pennsylvania; the Waugh & Porter and Richburg sands of western New York; the 100-Foot, third and fourth sands of Butler County, Pennsylvania; the Salt sand, Maxom, Big Injun, Gordon and fifth sands in West Virginia; and the Cow Run, Berea, Clinton and Trenton sands of Ohio. In Illinois the Casey, Robinson, Bridgeport, Kirkwood and McClokley are well known; and in Oklahoma there are a number of different producing sands, the Bartlesville being the most extensive. In the Gulf Coast, Louisiana and Texas fields, the sands occur more in irregular lenses and the production is in pools.

IT is approximately true that any hole in the ground, anywhere, will yield water if we drill it deep enough. That the corresponding proposition for petroleum is not true every layman must understand, and if he did not the general knowledge of wildcatting and its huge losses would make him realize the facts. It is doubtful, however, whether the layman understands why this should be so, or has any very clear conception of the geological status of oil. How does it occur, and where, and why? These are questions of much interest, and it is in the attempt to answer them that Mr. Messerly writes the present article.—THE EDITOR.

Reducing Noise in Factories

MANY authorities believe that loud and continuous noises exert a baneful effect upon the nervous system, and are responsible for much of the nervous disturbance and maladies of the nerves, which are, apparently, on the increase among dwellers in the cities. Even when the victim is so habituated to the noise which surrounds him as to be hardly conscious of it the noise may, nevertheless, exert a deleterious effect. In a recent number of a German technical magazine, an engineer named Walter Ritter, has suggested certain methods for reducing the inescapable noise in factories, machine works, mines, etc., to the lowest possible minimum. His basic idea is that it is less important to reduce the actual noise than to check the spread of the vibration to which the noise is due, since in his opinion it is such vibrations that chiefly affect the nerves, having a more injurious effect than the pounding of a steam hammer or the buzzing of a motor.

The first law he lays down is that the foundation upon which a piece of machinery is erected must be absolutely solid and resistant to pressure, and he suggests that a suitable material for making such foundations is armored cement or else a masonry of slag set in mortar of pure cement. However, this foundation does not lessen the noise, since each of the two materials suggested is an excellent conductor of sound. One or the other of these materials is essential because of the firmness and solidity, but Mr. Ritter suggests the mixing of the cement with quartz sand and finally broken stones to form a sheet 10 centimeters in thickness as the first layer of the foundation. Upon this are placed successive layers having a slightly different composition, gray lime and kieselguhr, each layer being firmly connected with the one below. The uppermost layer which should be from 10 to 20 centimeters thick should consist of kieselguhr cement. A foundation built in this manner possesses the property of deadening sound considerably and also reduces the vibration since the use of the kieselguhr has the effect of imparting elasticity to the cement.

Vibration is further reduced by means of an insulating material. Rubber might be considered best for this purpose, but rubber does not assist in lessening the noise. The best material for laying under the machine has been found by experiment to be a thick wool felt, the so-called iron felt with an impregnated surface or crust. Such felt exhibits great resistance to pressure combined with a high degree of elasticity. It has been shown by experiment that this felt is not "deformed" by loads up to a pressure of 1450 atmospheres. Such favorable results have been obtained by this method of constructing machine foundations that it is to be expected their use will be rapidly extended.

Electronic Classification of the Elements

DAUVILLIER, in *Revue Générale de l'Electricité*, lays stress on the recent advances in this subject, due chiefly to the use of X-rays, and makes special reference to the formula published by Moseley and the subsequent classification of substances by numbers irrespective of atomic weight, etc. He discusses very fully the electronic structure of atoms and molecules as discovered and published by numerous investigators. The elements are then tabulated in a table having eight vertical columns, representing chemical valency, and eleven horizontal columns representing the number of layers of electrons.

The Red Sea Dollar

How a Trade Coin of More Than a Century's Standing Is Being Retired

By Frank Parker Stockbridge

RECENT reports from Arabia and the African coast of the Red Sea point to the success of the interesting effort of the Italian Government to substitute an Italian coin for the Austrian Maria Theresa dollar, which for more than a century has been the standard unit of value and medium of exchange in the entire Red Sea district.

An Italian decree of May 31, 1918, provided for the coinage at the royal mint of a silver trade dollar to be known as "The Dollar of Italy." Primarily intended to be used in the Italian colony of Eritrea, the expectation that it would eventually displace the Maria Theresa dollar throughout the Red Sea commercial district seems about to be fully realized. The first million of the new dollars were readily accepted by the natives of Eritrea on a parity with the Austrian coin with which they had been so long familiar, and they were found to pass readily across the borders of the colony on the same basis in dealing with the other countries and colonies adjacent.

The Red Sea commercial district includes Eritrea, Abyssinia, Somaliland (French, British and Italian), Makalla, the Aden Protectorate and the Arabian provinces of Yemen, Asir and Hedjaz, now erected by the terms of the Treaty of Versailles into the independent Kingdom of the Hedjaz. Throughout this district the Maria Theresa dollar has circulated for much more than a hundred years. The coin was first minted in 1780 at Trieste, and up to 1914 large numbers were minted annually, all, curiously, bearing the original date, 1780, there being no apparent necessity for changing the original dies. The best obtainable estimates at the beginning of the war were that more than 200,000,000 of these trade dollars were in circulation or hoarded in the Red Sea district.

The rise in the price of silver during the war resulted in the buying up of many of these dollars by traders, for export as bullion, and Mr. Addison E. Southard, United States Consul at Aden, from whom many of the facts here set down were obtained, places the proportion of Maria Theresa dollars thus withdrawn from circulation at more than one-third of the total number.

With no new supplies available, and the natives uneducated in the values of any other form of coinage and totally ignorant of the use of paper money or of checks and drafts, there resulted a serious shortage in the medium of exchange for commercial purposes and traders found themselves, in the late years of the war and the period immediately following, reduced to actual barter in order to obtain the coffee, skins, hides and other products of the region. The actual cotton piece goods or other manufactured commodities had to be shown and exchanged on the spot, in many instances, to induce the natives to part with their wares.

The new Italian dollar was designed not only to supply this lack for the colony of Eritrea, but to extend Italian political and economic influence throughout the Red Sea district, and this result seems to be well under way toward accomplishment. The Maria Theresa dollar was coined in Trieste for private demands and a mint charge of 1½ per cent. collected. It was solely a trade dollar and was not issued for Government use. The new Italian trade dollar is coined in Rome for the Eritrean government but will also be coined upon private demand, as it is not intended to displace the Italian currency which is the legal circulating medium in Eritrea, but solely to be used as a trade dollar.

On the new coin the effigy of symbolic Italy, much resembling that of Maria Theresa on the old Austrian coin, is the principal device. The Maria Theresa dollar has a brooch of ten jewels on the shoulder of the robe; by examining these jewels to see whether or not they were worn smooth the native trader estimated the possible loss of weight in the coin in hand. This brooch is omitted in the new Italian piece. The double-headed Austrian eagle on the reverse gives place to the single-headed Italian or Savoyard eagle, while the Cross of Savoy is emblazoned on the shield carried on the eagle's breast, in the same fashion as the arms of Austria are carried on the Maria Theresa dollar.

At first there was some objection on the part of the Mohammedan natives to the presence of the cross on the new coin, and the keen-eyed Arabs were quick to note the absence of the shoulder brooch. The difference in the inscriptions is of no significance, as the natives cannot read them in any language. On the whole, the design has proved attractive.

The new dollar is almost identical in weight and size with the old one. The Austrian dollar weighs 433.02 grains and is of silver of a fineness of .8333; the Italian dollar weighs 433.12 grains and is .835 fine. Each has a diameter of 40 mm., or 1.57 inch.

Offered in the Eritrean market at the price of 9 Italian lire, the new dollar was rapidly absorbed, although a premium of half a lira was offered by some traders for use in Abyssinia. "The Abyssinian," writes Consul Southard, "is a particularly conservative individual and it will probably be some time before he will accept the new dollar as the equivalent of the Maria Theresa dollar, even though it weighs slightly more."

The establishment of the Italian trade dollar in Abyssinia will work decidely in favor of the development of Italo-Abyssinian trade relations. The whole effort to substitute a new trade dollar for the old inaugurates an interesting contest between commercial progress and the intense conservatism of the Red Sea native producer. If the district can absorb, as is anticipated, some 2,000,000 of the new dollars annually, traders of all nations will find it much easier to do business than it has been since the coinage of the Maria Theresa dollars ceased, nearly seven years ago.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

"The President's Great Opportunity"

To the Editor of the SCIENTIFIC AMERICAN:

I note on your editorial page of the SCIENTIFIC AMERICAN bearing date of July 16th, an article entitled "The President's Great Opportunity."

I wish to express my most hearty approval of the stand which you have taken on the question of disarmament and the futility of war.

I have read the SCIENTIFIC AMERICAN for many years, and it has devoted much space to the description of the United States naval vessels of various types. I never could interest myself in these great machines, because they were designed either for the purpose of actually destroying human life and human property, or as a menace to the other nations of the world.

For the last century we have prided ourselves on the beneficent contributions of science, discovery, and invention to the well-being of the human race. The modern practice among the great nations of the world of turning these great forces into destructive agencies of war involves a contradiction which is so senseless and so absurd that one wonders sometimes whether the reason of man has been dethroned and replaced by the savage instincts of primitive man.

Your attitude is so reasonable, and the stand you have taken on this question is so firm that I am sure it will result in great benefit. It is unusual for the editor of a scientific journal to take such a stand, but it is absolutely fitting that he should do so; first, because war as a measure of settling difficulties is not only unscientific, but preposterous; second, because a declaration from such a high source carries with it a convincing prestige. Neither the results of the past war nor the prospects of future wars will bear a scientific analysis, and the stand you have taken is not only reasonable from the layman's point of view, but also scientifically sound.

Permit me, therefore, to commend most highly the position which you have taken in this matter.

Kokomo, Indiana. ELWOOD HAYNES.

Make Air-Stunting a Criminal Offense

To the Editor of the SCIENTIFIC AMERICAN:

As a former pilot in the Air Service, may I compliment you on your editorial, "Aviation Fatalities," in your July 23rd number. I agree most heartily that there is no place for stunt flying in commercial aviation.

It seems to me that any pilot who engages in stunt flying or any other needlessly dangerous maneuvers except in connection with military aeronautics is guilty of sheer criminal negligence. It would be a great help to the cause of commercial aviation if legislation could be enacted to provide adequate punishment for such practices.

Very few pilots who have kept up their flying have died of old age. I believe such editorials as yours are helpful in forming a public opinion which will insist on pilots exhibiting at least enough self-control to refrain from practices which jeopardize not only human lives but the development of a vital industry.

Philadelphia, Pa. EDWARD M. POWELL.

The Bird-Cage Problem

To the Editor of the SCIENTIFIC AMERICAN:

The following is an attempt to answer A. B. C.'s question, which appeared in the correspondence column of the SCIENTIFIC AMERICAN for June 11, and reads as follows: "A bird sitting on a perch in a cage is weighed together with the cage. How does this total weight compare with the weight of the same cage but with the bird flying in it? Why?"

Such a question tends to test the reasoning power of a student of science, inasmuch as he is called upon to apply the scientific principles that he has so studiously acquired. A law of science is often called upon to solve many a unique problem, but quite often its application is only perceived after minute observation.

In this case, I believe that the problem can be most clearly stated in a concrete form, which for simplicity may be as follows: A cage is placed upon the pan of a spring scale or balance. The indicated weight of the cage complete with its perch, we will assume to be four pounds. If we then place a canary, weighing, say, three and one-half ounces, on the perch in the cage, the dial hand will show that the total weight is four pounds, three and one-half ounces. This is of course obvious, because the bird is suspended by the perch, which is in turn suspended by the cage. Now, then, let the bird take to flight, and immediately the dial hand returns to four pounds, showing a loss which is exactly equivalent to the weight of the canary, *i.e.*, three and a half ounces.

You ask why this is so?

What has become of the weight of the bird? It is against the laws of the conservation of matter and energy to suppose that the bird has lost his weight, and therefore weighs nothing. Yet the dial hand would have us believe so. The duty of upholding the canary has been transferred from the perch to the surrounding atmosphere, and this reaction of the atmosphere against the muscular force of the canary extends *beyond* the cage. But on the other hand if the air were a component part of the cage (such as would be ideally represented by one made of glass and air tight, of course having air confined in it for the bird's sake) then the dial hand would indicate the same weight whether the bird was flying or at rest on the perch. In flying in such a closed system, the reaction of the air to the muscular power of the bird does *not* extend beyond the cage.

Such a closed system forms a gravitational unit, and containing as it does a certain definite amount of matter subject to the action of the earth's gravity, no change of position of its integral parts can be expected to change this mass.

In summing up, the flying bird cannot be weighed directly unless the air in which it flies is confined within the boundaries of the cage. If on the other hand the air is not confined, the flying bird registers no weight.

I believe I have made myself clear in this explanation. GEORGE H. LEDL.

Cleveland, Ohio.

Buoy or Buffer?

To the Editor of the SCIENTIFIC AMERICAN:

Re your last issue (July 3), "Is Sauce for the Goose Also Sauce for the Gander?" I note Mr. C. E. Randall's sarcastic letter which is worth printing since it is at the expense of some newspaper. But what of the SCIENTIFIC AMERICAN, which describes an old automobile tire applied to a mooring buoy in these words, "to keep it afloat, thereby replacing the cork filling," etc.

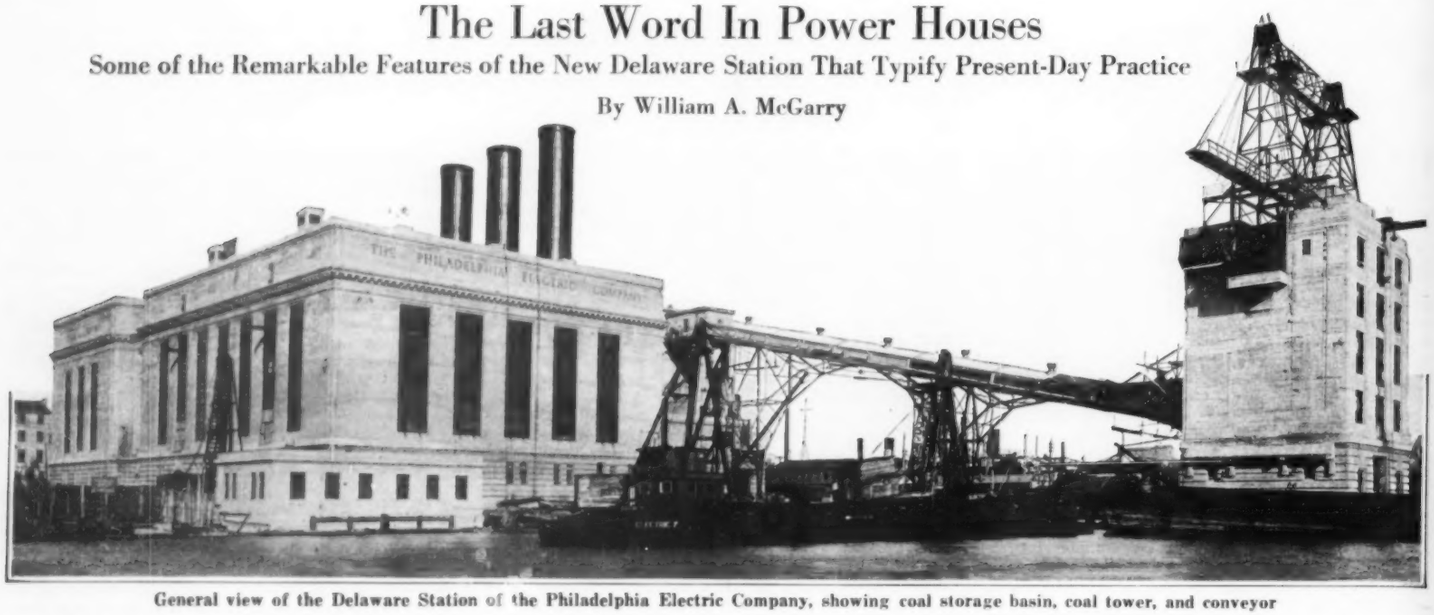
The photograph shows a hollow sheet metal buoy in which air is employed "to keep it afloat," and the only office of the tire is evidently to prevent injury to the hull of the small boat (or flying boat) when "picking up" the buoy. E. PAUL DU PONT.

Montchanin, Del.

The Last Word In Power Houses

Some of the Remarkable Features of the New Delaware Station That Typify Present-Day Practice

By William A. McGarry



General view of the Delaware Station of the Philadelphia Electric Company, showing coal storage basin, coal tower, and conveyor

ELECTRICITY is so well known as a labor saver that most consumers and even many of the big producing companies take it rather as a matter of course. It might also be said that progress in the science of producing electrical energy has been so rapid that advertising has found difficulty in keeping pace. For that reason the illustration used by the Philadelphia Electric Company in introducing to the public its new Delaware Station, held to be the world's most modern power house, is of more than ordinary interest. In announcing that the first thirty thousand kilowatt turbo-generator in the station had been placed in operation, the company pointed out that this one machine will do the work of a million and a quarter men, based on a twenty-four hour day.

In size and total power output there is nothing particularly new to modern engineering practice in this plant. Its second unit started operation December 31, 1920, and eventually there will be six generators of thirty thousand kilowatts each, each operated by four steam boilers. But in methods of construction, material used and electrical equipment the plant marks distinct developments of almost incalculable value, chief among which from the viewpoint of the power company man is the pipe room devised by the Engineering Department of the company.

Construction features of the building are unique. They are of interest not only from the engineering point of view, but also in a popular way as demonstrating the ingenuity of modern technical skill in overcoming obstacles even when faced with the lack of material that has been considered essential. Work on this plant was started just about the time the United States got into the World War. Before anything but preliminary excavation had been done it became apparent that it would be impossible to obtain the structural steel in time, because of the demand of the ship yards and munitions plants. A building constructed entirely of reinforced concrete had not even been considered, particularly after soundings which showed that bed rock was from twenty to forty-eight feet from the surface.

The site of the plant is the old Neafie and Levy Shipyard on the banks of the Delaware River, on a plot between Penn Treaty Park and a section of the William Cramp and Sons Ship and Engine Building Company. Concrete is not used exclusively in electric power plant buildings, as a rule, because of the tremendous loads to be carried, particularly in the boiler rooms. The special ground conditions here made it seem more impracticable than ever. But when the engineers were convinced that it would be impossible to get the steel during the war, and that without some substitute the work must be abandoned for some years, they began to consider what might be done.

Old designs for the plant were discarded and an entirely new set of plans were drawn. This called for reinforced concrete construction throughout, save for the use of I-beams from which to suspend the boilers. Later in the work steel was obtained for the roof trusses and conveyor bridge. It has been the practice in such plants to carry in bunker storage from five to six thousand tons of coal. If the old plan of weight distribution had been followed it would have been necessary to construct the supporting columns and foundations so large as almost to eliminate the limited aisle space in the boiler rooms and elsewhere. In general terms it might be said that the main problem of the new design was the elimination of weight. This was achieved primarily in the coal bunkers.

Provision was made here for the storage of but one thousand tons of coal, instead of five or six, the location making it possible to provide for ample storage up to twelve thousand tons on barges in a basin between the bulkhead and pier head lines. This storage is essential to assure continuous service. Various other minor economies of weight were made wherever possible.

Several expensive and tedious methods were available for sinking the foundation pits to bed rock. The one adopted was devised by Samuel L. Shuffleton, one of the construction engineers at work on the project. In the center of spots marked for columns, ranging in diameter from ten to fourteen feet, he drove a heavy pile which was used as a base for a mast. On this was mounted a trip hammer on a revolving carriage. Sheet steel, interlocking piling was then driven into the earth on the outer line of the foundation column, the hammer revolving and striking each sheet in turn until bed rock had been reached. By this method the piling was driven through boulders, ancient wooden piles and all manner of obstructions.

When the entire circle of steel piling rested on bed-rock the mast was removed and the earth and mud within were siphoned out. Bed rock was cleared by pounding with a section of steel rail. A steel cylinder, flared at both ends, was then lowered into the pit. Concrete poured into it settled on bed rock and as the pit filled, the cylinder was drawn up, until all the water had been replaced by concrete. By this method pressure on the steel piling was maintained virtually uniform within and without during all the stages of the excavation. Thus foundations were placed.

There are four boilers to each turbo-generator, so that the total in the completed plant will be twenty-four, of which eight are now in place. Water is supplied to the condensers through six-by-ten foot tunnels from the river. Since such tremendous quantities will be used for the completed plant, it was necessary to provide special cooling arrangements. Discharge tunnels empty into the river directly under the coal tower pier, which projects from the bulkhead line at the center of the company's property to the pierhead line in the river. The intake is from the east basin. Steel sheet piling was placed on the east line of the coal pier and extending some distance from the mouth of the discharge tunnels. As the relatively warm condensing water is discharged it strikes the supporting piles of the pier and is broken into many streams. These in turn are deflected by the sheet piling into the west basin, from which the water must pass around the end of the pier

(Continued on page 197)

Left: Five of the caissons for the foundations of the Delaware Station. Note the retaining wall of sheet steel piling back of the railroad track, which made possible the use of hydraulic excavation as shown in the foreground. *Right:* View of turbine hall in the Delaware Station, with one of the huge generating units and condenser in the foreground

Before and after phases of the Delaware Station: Excavating for the foundation and the finished turbine hall

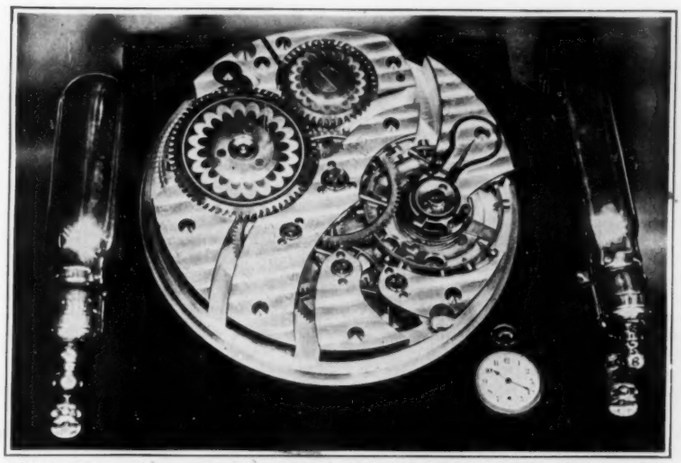
The World's Largest Watch

HISTORY records the making of some huge timepieces, like the turret clocks of old with hands ten feet long with a bell which could be heard twenty miles away. But it remained for the experts of our own day and generation to produce the biggest watch known to the science of horology.

It is true that watches were, in the beginning, very large on account of their striking part, when the case was pierced to let out the sound of the bell; yet these huge watches were mere pigmies compared with the giant timekeeper recently exhibited at the National Museum in Washington. Great crowds flocked to see the details of construction and observe the mechanical action of the object which is the guardian of man's habits and the critic of his wasted moments.

The big fellow is 9½ inches in diameter and 1½ inches thick, or six times as large as the standard watch. It is said that the average time required to build a good watch is nine months, and that it often takes a full year. If this be so, one can be led to fanciful speculation as to how long it took to make the various parts of the mammoth watch and to assemble and test them, for this interesting specimen is complete and perfect in every detail. Pivots, staffs, balance, hair-spring — everything, in fact, is exactly like the watch which you carry around in your vest pocket, even to the twenty-three jewels (synthetic, of course) specially cut and designed. The train, which, technically, is the series of wheels carrying the motive power from the barrel through the balance and escapement, is of gold, the cogs and teeth of the train-wheel having been treated in a particular manner to harden them for wear. The winding-wheel and other parts are of steel. There is but one difference between this ace of the industry and the watch of normal size, and that is in the motive power. It has a mainspring which measures nine feet from tip to tip but which is hardly strong enough to move the train. The masters of the art, who built this thing of scientific perfection, knew that the finely-tempered steel might snap, so they ingeniously devised a weight to keep the works in motion. By way of interest there are presented herewith a number of photographs of standard watch parts, greatly magnified, so as to give some idea of the delicate nature of such mechanisms.

Would that the students of the dead centuries could see this horologe! The clocks of St. Paul's, Westminster and the rest must seem like crude affairs when arrayed with this mechanical marvel of our own day. Built at a cost of $5000, and from the standpoints of finish and excellence of handiwork comparable to its little brothers, the monster watch will be famed as a national educator as well as a curiosity for a long time to come.

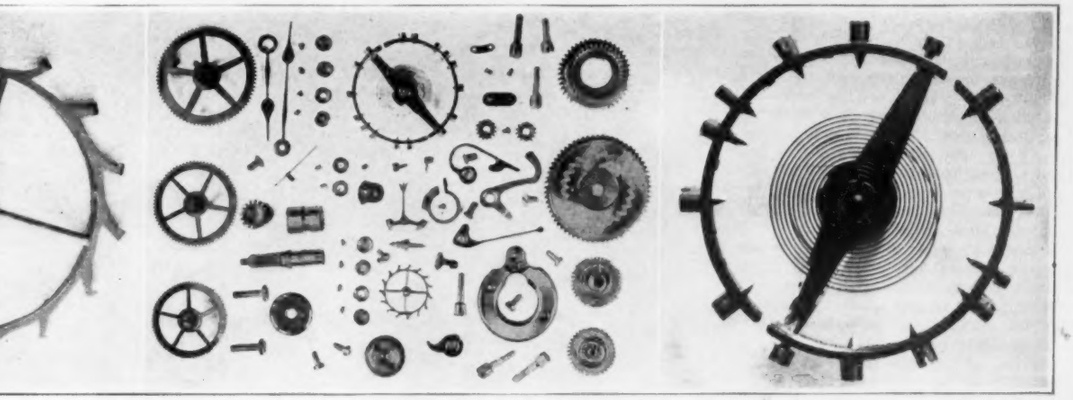


This huge watch measures 9½ inches in diameter and 1½ inches thick. It cost $5,000 to construct, and has been placed in the National Museum

Past and Present of American Railroading

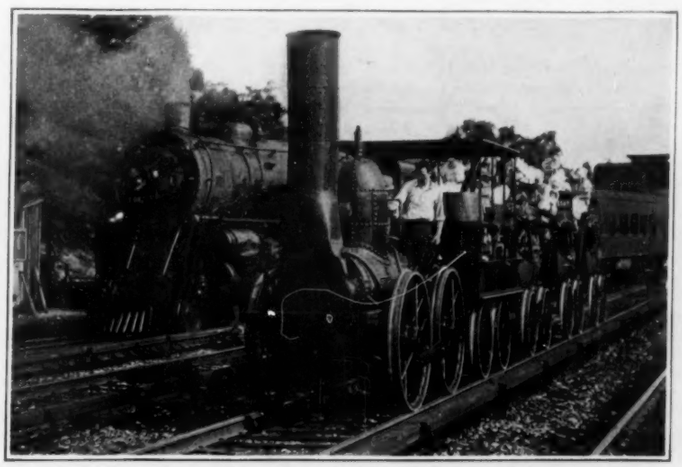
PRIOR to sending the famous De Witt Clinton steam locomotive to Chicago to participate in the Pageant of Progress that is to be held in that city, the old locomotive and its train of coaches were tested over the New York Central tracks in New York City and vicinity. The DeWitt Clinton locomotive, it will be recalled, was the first steam rolling stock of the Mohawk & Hudson Railroad—the original unit of the New York Central Lines. It made its first trip over the road from Albany to Schenectady on August 3, 1831.

Standing on a track alongside one of the huge Pacific type steam locomotives of today, the little DeWitt Clinton locomotive presents an interesting contrast in railroading. It measures 12 feet 10 inches long and 8 feet 5 inches high. It weighs 12,098 pounds. The modern locomotive alongside, which hauls one of the through fliers, weighs about 17 times the weight of the entire DeWitt Clinton train. The old locomotive is fired with wood, and in a recent test it developed a speed of 15 miles per hour when pushed to the utmost.



Left: Escapement parts of 16 size 17-jewel watch, considerably magnified. The escape wheel makes a turn every six seconds, and is alternately released and checked by the "pallets" or white sapphire stones seen in the ends of the cross-arm. At the end of the "level" is the "fork", which is shown in this view, but which receives motion from and imparts motion to the balance wheel through the "roller jewel" fixed to the balance. *Center:* The smaller parts of a 16 size 21-jewel watch. *Right:* Balance and hair-spring of 16 size 17-jewel watch, considerably magnified. The rim is made of two segments of steel and brass, the steel being inside. Temperature changes cause these segments to curl slightly in or out, thus compensating for the increase or decrease of elasticity of the hair-spring. The screws provide means for properly distributing the weight. This little wheel makes 5 vibrations per second, or over 157,000,000 per year, turning on pivots slightly larger than a human hair. A point on the rim travels nearly 5,000 miles a year

Enlarged photographs of the parts of a standard 16 size watch, showing the complexity of construction



The old and the new in American railroading: DeWitt Clinton train of 1831 alongside a modern passenger train

Electric Resistance of Human Body

MEASUREMENTS as to the electric resistance of the human body, without including the opposition through the skin where the current entered and departed from the body, for the first time, have been made by F. Wenner of the National Bureau of Standards. The conclusions are at variance with those previously announced by M. Gildemeister, a German scientist, whose methods of measurement were dissimilar. The elimination of the substantial and uncertain resistances through the skin is responsible for more representative determinations than heretofore attained.

Interesting is the deduction that the same portion of the body of different individuals may vary in the degree of electric resistance by a ratio of three to two or even more. Also, the opposition of the individual varies from day to day and frequently by slight degrees within the hour. The position of the body and the extent to which the muscles are relaxed are likewise influential factors contributing to variations in resistances. The pathologist is invited to study these differences inasmuch as some of the changes are due to the conditions of the body as it pertains to the science of diseases.

The experiments were conducted in a laboratory of the Bureau of Standards, the feet of the person submitting himself to the test being soused in a bath and the hands also placed in salt water, being immersed slightly above the wrist. An alternating current of a few milliamperes was passed from hand to foot, and the potential drop caused by this current between the other hand and other foot was measured by an alternating current potentiometer. The ratio of this difference in potential was considered as the resistance. The trunk of the body was found to have a resistance varying for different individuals, but on the average it is about 25 ohms.

For the frequencies used, 25, 60, and 100, the resistance was found to be independent both of the frequency and of the current. Inasmuch as a current of .1 ampere through a vital portion of the body may cause death, the scientist considers it of interest to know that this corresponds to a potential drop of only a few volts in a vital part of our body.

The Heavens in August, 1921

Dark Voids in the Starry Skies, and What They Mean

By Prof. Henry Norris Russell, Ph.D.

AS we look out into the summer skies, on any clear moonless summer evening, we cannot fail to notice the great brilliancy of the southern Milky Way. Almost from Altair to the horizon, there is a long succession of clouds and patches of light, whose brighter portions far exceed any other regions of the Galaxy which can be seen in our latitude.

Our first impression will probably be of the brightness, and the patchy character, of the luminosity. Upon a second and more careful survey, we will notice that all through this quarter of the heavens the Milky Way is double. Beside the conspicuous stream which first catches our eye there is another; further to our right, fainter, and in many places wider. Looking upward, we find that these two branches of the Milky Way may be traced northward beyond the celestial equator, and all the way into Cygnus, where they blend with the single stream which we know in the winter skies. In the opposite direction the division of the Galaxy extends down to our horizon, and far beyond. Southern observers can follow it up to the Cross, where again the single band of light replaces the double.

Between the two branches of the Milky Way the sky is dark—fully as dark as the background of the heavens outside the Galaxy, and in places even darker. On a really clear night, when the zenith sky seems powdered with tiny stars, almost too faint for the eye to hold in direct vision, one may notice several of these dark regions. The most conspicuous one lies to the west and north of Sagittarius, where, on the edge of the bright star-clouds, there is a dark region several degrees long from which lanes almost as dark run westward—one nearly toward Antares, the other a few degrees higher up.

Another dark region, in Cygnus, which extends almost across the Milky Way, like a bar of cloud, is usually more conspicuous to one star-gazing, since it gets so much higher in the sky. It is only in clear, brilliant skies, such as may be found at mountain observatories, that the unaided eye can do much to detect these regions. A city sky, veiled with haze and illuminated by street lights, is almost hopeless.

What the Camera Tells Us

But the real extent and nature of these dull patches in the heavens is revealed only by photography. For our present knowledge we have to thank primarily the skill and assiduity of Professor Barnard, who has studied these objects for years, and gradually convinced the scientific world of the truth of his views.

Put briefly, his contention is this: that these dark regions are not holes in the star-clouds of the Milky Way, through which we see into the dark depths of space, but actual clouds of obscuring matter, between us and the Milky Way, which hide it and in places practically blot it out from the view of our earth-bound instruments.

The reality of this obscuration first becomes apparent in the case of the darkest markings, such as those between Sagittarius and Scorpio, in the southern part of Ophiuchus. Here the stars seems practically blotted out, so that there are regions where hardly one can be seen in the field of view of a great telescope—though, only a few degrees away, hundreds appear in a region of the sky of the same size.

It is only here and there that the "dark nebulae" are entirely opaque. More often a few scattering stars can be seen through them—probably greatly dimmed. They cannot be studied profitably with large telescopes—unless one wishes to examine some small and unusually sharp bit of detail. For the most part they are so big that only the wide-angle camera can display them, and a small instrument will then suffice. Photographs, exhibiting them as beautifully as the writer has ever known, have been shown by a colleague here, which were obtained with a hand camera (the lens of the highest grade), strapped to a telescope which served to keep it accurately pointed at the stars during exposures which often ran into many hours or even a whole night. With such an equipment it is hard to find any large region of the Milky Way in which there is not some evidence of obscuration; and in many places it is remarkable.

On looking at such a plate, one is moved to ask two questions. What are these vast dark clouds which come between us and the Milky Way? And where are they?

Bright Nebulae and Dark Regions

The second question is in some ways easier to answer. These obscured regions are permanent features of the heavens; hence they must be produced by something out among the stars. In many cases they are connected with regions of diffused visible nebulosity. For example, the dark lanes in Ophiuchus run up to the large patches of faint nebulosity which surround the stars Rho Ophiuchi and Nu Scorpii, in such a fashion that there can be no doubt that the luminous nebula is simply a part of the dark region, which is caused to shine for some reason connected with the presence of the stars about which the luminosity is condensed.

In these cases we may be practically sure that the nebulae, both bright and dark, are at substantially the same distance as these stars. In this way we can say with some assurance that the obscuring clouds in Ophiuchus are at a distance of about 400 light-years. Another prominent group of regions of obscuration appears to be connected with the bright stars in Orion, and the great nebula there; and we may estimate its distance as 600 light-years.

Still another such group lies in Taurus. The distance of this group, which is one of the largest and blackest of all, has been estimated by the Dutch astronomer Pannekoek in another way, by counting the number of faint stars per square degree in the dark regions and outside of them, and calculating, from our present knowledge of the distribution of the stars in space, at what distance the absorbing screen must be in order to obscure the observed proportions of the stars of the various magnitudes. He concludes that this screen is about 500 light-years distant.

These three great obscuring clouds are therefore near us, in comparison with the star-clouds of the Milky Way, whose distance may be roughly estimated as from twenty to fifty thousand light-years, if not more. It is, however, probable that there are many other and more remote dark clouds, which look smaller because of their distance.

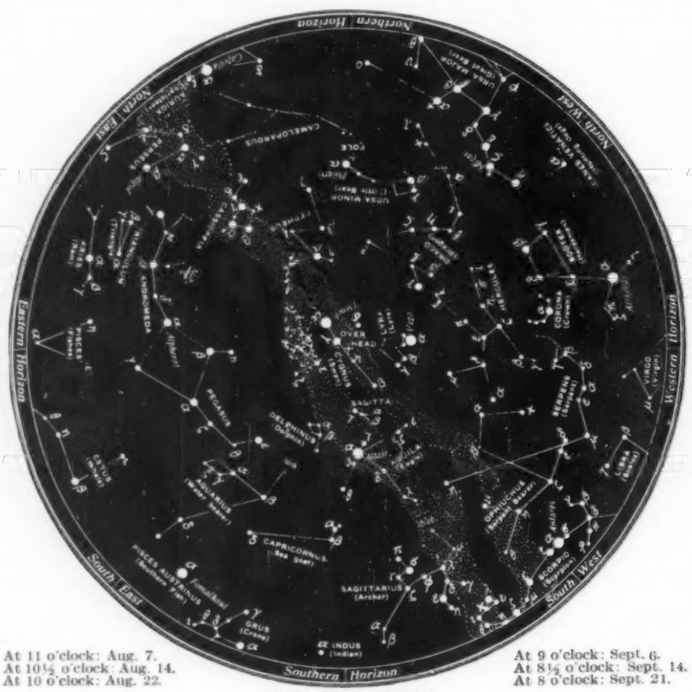
The Nature of the Dark Clouds

With regard to the true nature of these clouds, it is evident that they must be vast aggregates of some form of actual matter—and a very little consideration shows that the form of matter which is most effective must be fine dust. A cloud of fine particles—whether of actual dust or of the minute drops of water which constitute a fog—may be much more opaque in a few inches' thickness than all the many miles of air in our atmosphere. Larger particles, such as pebbles or rain drops, could also form an opaque cloud if there were enough of them; but calculation shows and common sense confirms that the same quantity of material, if broken up into smaller dust grains or drops, would suffice to make a far larger and denser cloud. If then in these dark nebulae we have actually a mixture of things, of all sizes—from great lumps of rock to separate molecules of gas—the fine dust particles and fine drops (of about the size of a wave length of light) will be so much the best cloud-formers, pound for pound, that unless they are present in an extraordinarily small proportion they will account for most of the observed obscuration.

These clouds of cosmic dust, mixed with we know not how much gas or how many larger lumps of matter, are the hugest objects known to science. The great masses in Ophiuchus must be more than fifty light-years long and several light-years wide. Those in Orion are probably bigger; and Pannekoek estimates that the full extent of the cloud in Taurus is 200 light-years.

It is beginning to look probable that much, if not all, of the dark lane which runs down the Milky Way, and splits it in two for almost one-third of the circuit of the heavens, may be explained by similar obscuring matter, lying here and there, cloud behind cloud, and hiding from our eyes perhaps the grandest part of the stellar universe. Such a cloud mass must be thousands of light-years in extent.

Of course, these vast clouds are not solid. They are probably incomparably less substantial than the thinnest terrestrial fog—for a few rods of the latter will absorb more light than a billion miles of the former. How they got there we need hardly ask. Of all things visible they seem nearest to the primeval chaos. Indeed, they might well be described in the scruptural phrase "without form and void . . . darkness upon the face of the deep."



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.

At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

At 9½ o'clock: Aug. 29.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens

The region of the sky of which we have spoken is nearly in the south earlier in the evening, but well in the southwest at our hour of observation as indicated on the map. Scorpio is setting, with Sagittarius above on the left, and Aquila higher. Cygnus is right overhead; then, along the Galaxy, come Cepheus, Cassiopeia, and Perseus, low in the northeast. The Great Bear skims the northwestern horizon, with Draco and Ursa Minor above. Lyra is high in the west, with Hercules and Bootes below. Turning eastward we may see Pegasus and Andromeda, with Aquarius, Capricornus and the Southern Fish in the southeast.

The Planets

Mercury is a morning star at the beginning of the month, and rises at about 3.30 A. M. He soon draws in behind the sun and passes through conjunction on the 23rd, to reappear next month. Venus is a morning star in Gemini and Cancer, rising before 2 A. M. at the beginning of the month, and about half an hour later at its close. Mars is a morning star, too, but too close to the sun to be easily visible.

Jupiter and Saturn are evening stars and are getting closer together in the sky as they pass into the twilight.

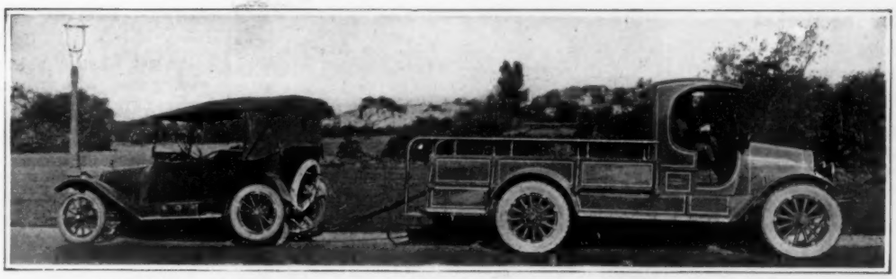
(*Continued on page 108*)

Towing the Wrecked Car

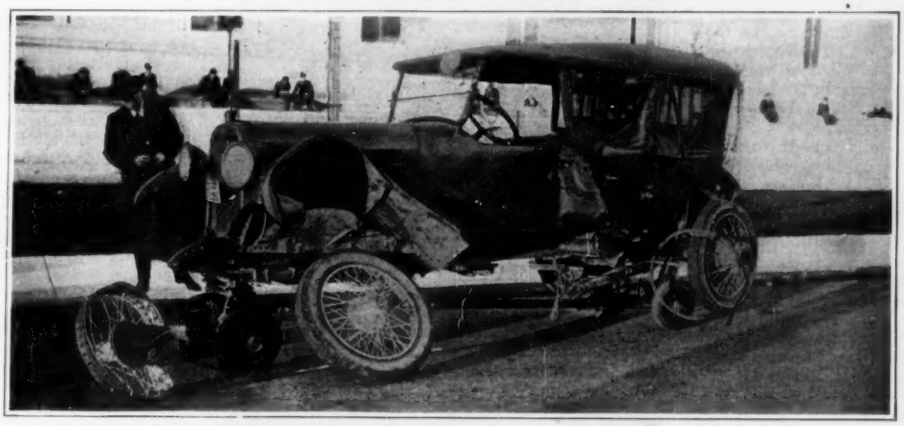
WE are accustomed to the sight of an automobile being towed to the repair shop, with its chauffeur at the wheel to guide it in the tracks of the towing machine. But this procedure demands that the crippled car be towable—that is to say, that it have four good wheels and two good axles. When this demand is not met, some other means of getting the wreck to the hospital must be employed. It will doubtless be surprising to many readers to learn that it is by no means necessary, under these painful circumstances, to load the damaged car bodily on to a big truck. The fact is, it can be towed through the street with perfect ease, and actually without anybody at its steering wheel. The apparatus through which this result is attained is known to the garage man as the dolley. It is in effect a temporary substitute for the crippled front or rear axle assembly, or even for both; with this suggestion our photographs will make its construction and operation clear.

When the car to be towed has one axle intact the procedure is even simpler. Our first picture indicates what happens in this case, and represents what would appear to be the more unfavorable case, where the rear axle is the bad one, so that the towed car must proceed backward. The disadvantage is merely an apparent one, however, as will be realized when it is remembered that the dolley is attached to the towing car with sufficient rigidity to make the steering of the towed car quite superfluous.

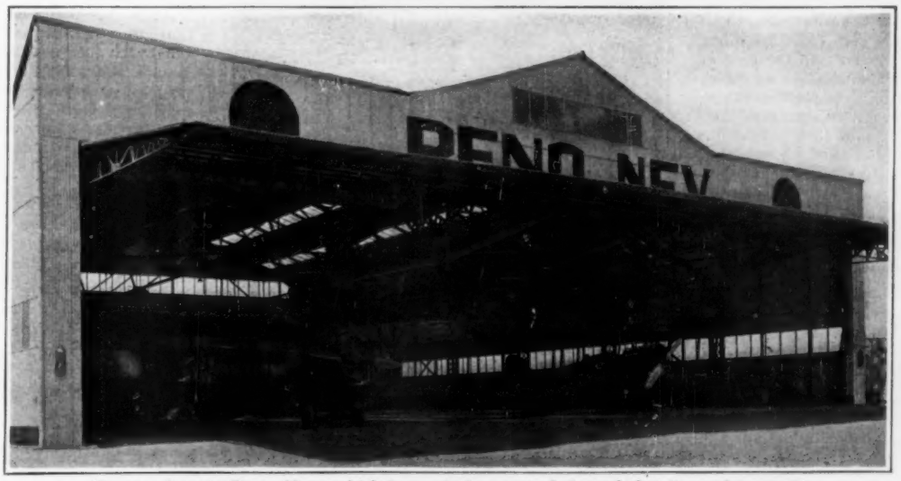
The automobile shown in the picture having four wheels wrecked, was towed to the garage without a driver at the wheel of the wrecked car. This was possible through the use of two dolleys as shown. The rear one is equipped with a telescoping tongue. This is placed under the rear axle and the telescoping tongue brought forward and attached to the front dolley where its end can be seen projecting through the bolster of the dolley that supports the front axle. A tripod has been designed especially for holding the dolley rigidly in the bed of the towing car. The tripod is permanently fastened to the bed of the service car, and holds the towing car dolley by means of a clamp which can be quickly opened for removing the dolley from the car.



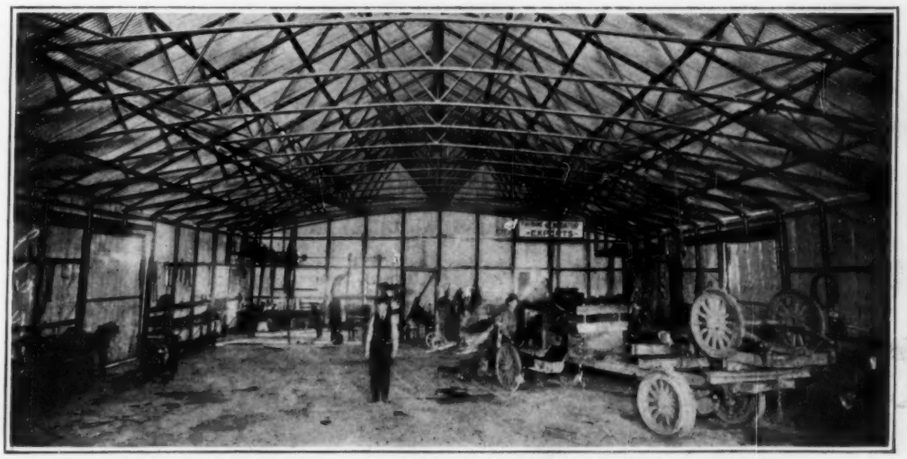
The dolley car in use to tow a car with one bad end; the rear end, in this instance



How the towing dolleys are assembled beneath a car that requires support both in front and at the rear



Hangar door in Reno, Nev., which is so nicely counterbalanced that it can be opened by hand by one man



The frame of this building is of tubular steel, welded into a single piece without rivets, bolts or screws

A One-Piece Welded Structural Frame

AMONG the advantages claimed for a new type of structure that has been developed recently in the Southwest, are great strength and durability, economy of fabrication, and exceptional sanitary features.

The truss welded frame structure differs from the heavy steel structures generally erected in that the framework is constructed of tubing in which the joints are made by welding. The completed frame is in reality one piece, eliminating entirely the necessity for rivets, bolts, screws or screwed joints. The roof, sidewalls and floors may be of any building material desired. The design is such that buildings of any required dimension can be erected without interior pillars. The claim of superior strength is based on the use of tubing, which, under certain kinds of stresses, is stronger than any other structural form of equal weight; and to the fact that the oxy-acetylene welded joint, which is remarkably tough, can be made even stronger than the sections of tubing joined, thus reinforcing the structural members instead of reducing their strength, as is unavoidable where threads are cut for screwed connections or holes drilled for bolts or rivets. The smooth finish of the welded joints also renders them less susceptible to rust and deterioration, thereby adding to the factor of durability. Economy of fabrication, both for material and labor, is claimed on the basis of the saving in tonnage on any required factor of strength and on the fact that the welded joint can be made

(*Continued on page 108*)

New Type of Hangar Door

THE municipal hangar erected by the city of Reno, Nev., to house the airships used in the transcontinental mail service, is unique in having a monster one-piece door 18 feet high and nearly 100 feet long. This door extends across the entire front of the hangar, whose dimensions are 100 by 100 feet inside clearance. When the door is open it forms an awning across the front. A five-horsepower motor operates the door, which is of the Strauss bascule overhead counterbalanced type, the only one in operation in the United States. There is also a hand-power chain block for operating it in case the electric motor fails. The door is so nicely balanced that one person can open and close it by hand power. The counterbalance is of concrete and weighs 37,000 pounds.

The hangar frame is of steel, and the roofing and siding of asbestos. One-tenth of the roof and sides is of corrugated glass for lighting purposes, making an exceptionally well-lighted building. By proper storing the building will house eight De Haveland-4 type of postal airplanes.

Preparing Bamboos for the Market

By H. L. Wright

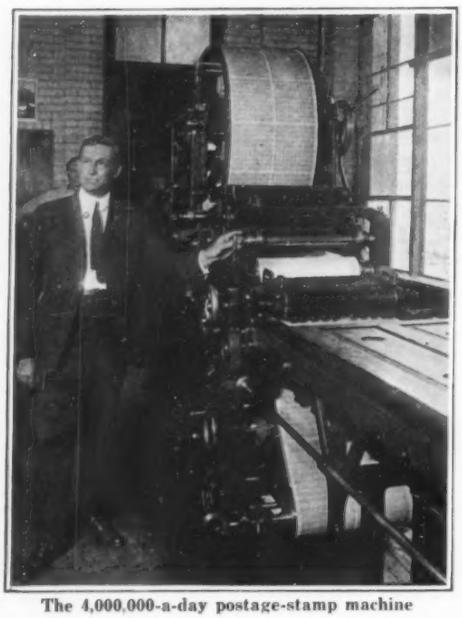
FEW forest operations in India are more interesting to watch than the preparations of raw bamboos for the market and the conversion of the rough, crooked, dirty-looking stem as it comes from the forest into the highly polished, rich brown lance stave or tent pole. But though a remarkable change is effected in the process, the methods employed are extremely primitive. Nevertheless they are efficient and it is doubtful if better results could be obtained with more up-to-date appliances.

The first stage in conversion is to cut the stems to the proper length and to clean off all the knots. This is usually done by a gang of small boys armed with sharp adzes. Knot-cleaning is an operation requiring a certain amount of skill, as if the skin is broken the stem is ruined. But after a short period of apprenticeship, during which they work on the less valuable stems, the youngsters become remarkably good at this work and it is rare for them to spoil a bamboo by making a bad shot.

After dressing, the bamboos are handed over to skilled workmen, known as *kammaggars*, whose sole business in life is the preparation of bamboos. Each stem is then warmed in a hot wood fire made of two large logs. This not only makes it supple, but also imparts the fine brown color, and by melting the dirty waxy covering gives the stem a clean and polished appearance. Once the stem has become sufficiently pliable all curves and kinks are taken out by bending with some force in an opposite direction. For this purpose two implements are used. The first for heavy stems is an upright pole planted in the ground in which slanting holes have been bored to take the bamboo; the second a stout stick with a groove in it, which is used for lance staves and other delicate work. To use the first the warm bamboo is inserted in one of the holes and the *kammaggar* presses on it with considerable force to bend it in the right direction. When using the second implement the *kammaggar* holds the stem to be straightened in his left hand and goes carefully along its whole length with the straightener . In the case of lance staves, where perfect straightness is essential, firing and straightening have often to be performed several times before the desired result is obtained. The illustrations give a better idea of how these operations are performed than any description, and though they sound very simple, in reality considerable skill is necessary—first to make the bamboo sufficiently warm without allowing it to scorch, and then to straighten it without breaking the fibers.

Alcohol As Locomotive Fuel

FROM Pernambuco in Brazil comes the news that there are approximately 80 modern cane-sugar factories, which have about 800 miles of railway, of from 0.75 to a 1 meter gage, operated at present by wood-burning locomotives. The fuel problem, however, is becoming a serious one and as a result the sugar-mill operators are turning their attention to reducing wood consumption and finding substitutes. Consequently great interest is being shown in the substitution of alcohol, which is produced in large quantities on the sugar plantations from the molasses finals. Pernambuco has recently adopted the use of alcohol to which 5 per cent gasoline has been added.



The 4,000,000-a-day postage-stamp machine

Dressing off the knots from the stems, another preliminary of straightening

Postage Stamps in the Making

By S. R. Winters

THE medical authority who visualizes a million germs, more or less, on the postage stamps you lick may have to revise his count if a machine designed by Benjamin R. Stickney, mechanic of the United States Bureau of Engraving and Printing, merits in ultimate applications that which its early triumphs foreshadow. The mechanism manufactures postage stamps with a negligible ratio of human assistance, and a heating process contributes to the sanitary make-up of the finished product.

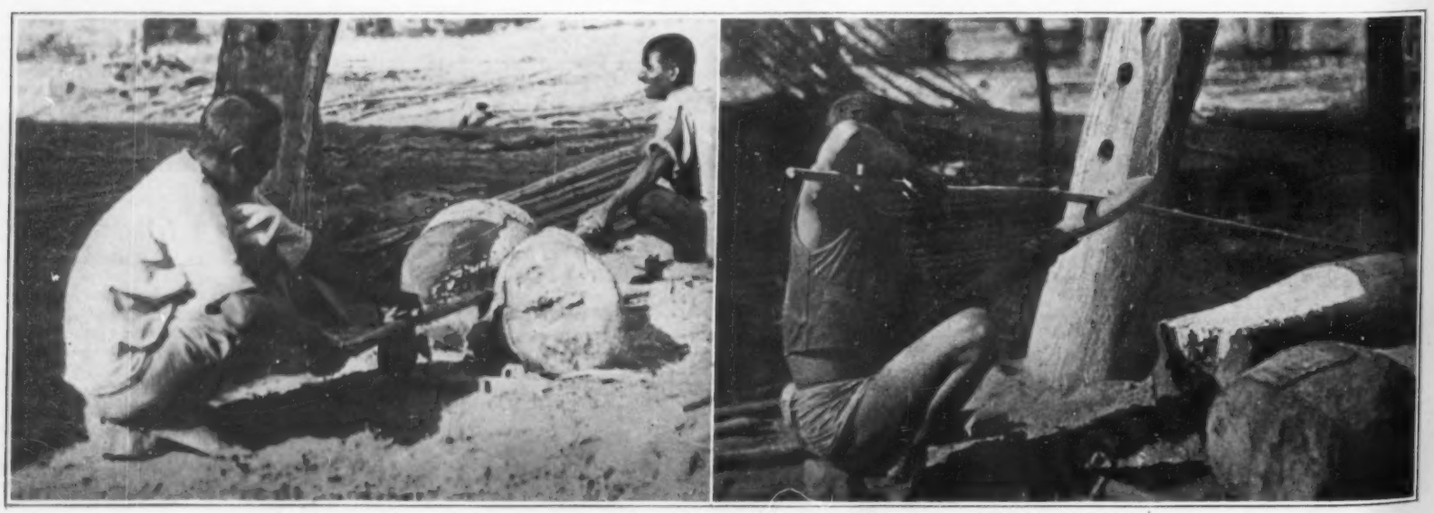
The so-called germ-proof method, evolved after seven years of unremitting effort, reduces the units of manufacturing operations from twenty-four to three. Three of the machines, already in operation, are capable of printing 12,000,000 stamps a day. Formerly, the postage tokens were finished in the form of sheets, the human touch being essential in divorcing the huge rolls into various units; or possibly, they might be marketed in book form.

The present-day vogue of stamp-vending machines and letter-stamping machines which have to have the stamps fed into them in endless coils a single stamp in width, however, has at once demanded a different mode of manufacture for the little engravings and made it possible to meet this demand. The stamps that are peddled out over the postoffice counter to the general public are still printed in sheets in substantially the same way as always; but the apparatus that we illustrate offers a far more expeditious, more economical and in general a more satisfactory process for printing and putting up the stamps of the coil variety. This process is as far removed from the old one as is the use of coils from the absurd cutting apart with scissors that was necessary with the unperforated sheets of stamps of 75 years ago.

By the new process, the stamps are printed, gummed, perforated and placed in rolls by machinery. When first printed, they are spun into rolls a foot long and a fraction less than one foot in diameter, the accumulation representing several thousand dollars worth. Forthwith they are separated into smaller units of 500 stamps and sealed. The inventor of the apparatus is credited with having designed in excess of 300 tons of machinery for application in various departments of the Bureau of Engraving and Printing. His scientific contributions have earned for him a substantial promotion as a government employee.

Stars of Composite Spectra

THE spectroscope is used in two ways to discover double stars too close to be separated by visual methods. In the case of ordinary spectroscopic binaries, the existence of a binary system is revealed by the shifting of the spectrum lines in consequence of varying radial velocity. There are other cases, however, in which the fact that a star is double is shown by a composite spectrum; *i.e.*, a spectrum produced by the superposition of two spectra of different types. Miss Cannon of Harvard Observatory has discovered 261 of these stars of composite spectra. Some of these are visual doubles, but in several such cases the companion star is too faint to give a spectrum.



Left: Firing the bamboos preparatory to straightening. *Right:* The delicate operation of taking the bend out of a long staff

Two steps in the preparation of bamboos for the market

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The tripod that replaces the second saw-man

The One-Man Cross-Cut Saw

OBVIOUSLY, it would seem inconceivable to operate a wobbling cross-cut saw without two persons to manipulate it! But a district forester in the employ of the United States Forest Service on a western Government reservation, prompted by the exigency of a scarcity of manpower, has eliminated the necessity of having a second person to hold the saw while cutting firewood.

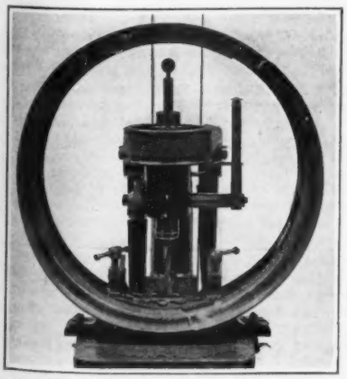
Obtaining three 2-by-4 scantlings, he fashioned then into a tripod-like shape, boring a hole through the top of them for the passage of a bolt, for holding the pieces together. A fourth leg, shorter than the other three, extends downward from the center of the tripod-like arrangement. The latter does not reach the ground, and has a free and easy movement. One handle of the saw is fastened to this "fourth" leg, and as the firewood is placed in position in a rack for cutting the operator saws with a facility that one would conclude that a second person was on the scene.

The "short" leg is so arranged that it is easily swung back and forth at the will of the operator at the other end of the saw. That the clever device is practical can be surmised by observing the pile of wood that has been cut, as shown in the accompanying photograph. The ingenious device has attracted no little attention in the neighborhood of this forest ranger's tramping grounds.

A Rim Drilling Machine

A MASSACHUSETTS manufacturer is using a machine specially adapted for drilling operations on the inside of rims of various kinds. This machine will drill holes on the inside of rims having diameters of 20 inches and upward. The spindle has a total vertical movement of 5 inches and the vertical movement of the table is 3 inches. The table has a working service measuring 15 by 17 in., which is ample for its purpose.

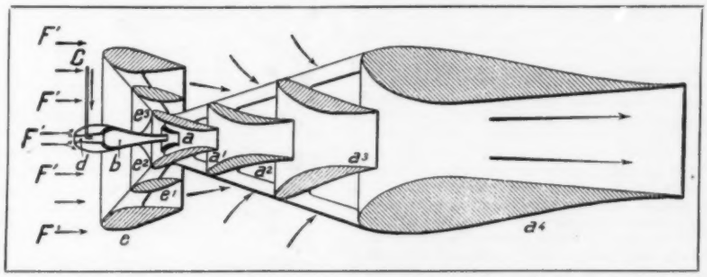
Instead of the usual taper wedge arrangement the spindle has a knock out rod for removing drills and is hollow. Two oil holes at the top of the spindle mounting provide for the oiling of the spindle bearings and driving pulley. Convenient operation is attained by the reversible ratchet feed of the spindle. The machine was made low, being only 50 inches in height, because of the special purpose for which it was designed.



For the speedy drilling of holes in rims of all sorts

The Plane That Blows Itself Along

A FRENCH engineer, H. M. Mélot, has put out an invention which from its form he calls the propelling trumpet. Capable of application to all sorts of vehicles, it is designed primarily for the airplane. The apparatus consists of a number of tubes, ending with trumpet-like flares or nozzles. These are arranged in series in connection with a combustion chamber, where an explosive mixture of air and fuel is ignited as in ordinary engine practice. The exhaust gases from the combustion chamber are discharged into the series of nozzles. Both the pipe that effects this distribution, and the nozzles themselves, are carefully designed to cause the expansion of the gases to occur under the best circumstances. It is the velocity of the exhaust and the velocity of expansion which, through reaction against the external air, drives the machine forward.



General scheme of the Melot system of propulsion through the agency of exhaust-gas velocity

The exhaust gases are discharged at a velocity of from 1200 to 1500 yards per second; and at the entrance to each nozzle a certain amount of the outside air is drawn in and surrounds the jet of exhaust gas as perfectly as possible. The gas therefore gives up a part of its velocity to the air and causes a powerful suction action at the entrance to each nozzle. This is of material assistance to the direct reaction against the atmosphere behind the machine.

The attached drawing makes clear the operation of the system. The nozzles, indicated by the several *a*'s of the drawing, are arranged one behind the other. In front of them is the combustion chamber into which the fuel gas is introduced by the pipe *c*. The air is delivered into this same chamber by a divergent tube *d*, placed preferably at the front of the plane. In front of the propulsor is an "expansion multiplicator"; this comprises the divergent-convergent member *e*, at whose narrowest section is the intake orifice of a second convergent-divergent conduit e_1. The system is composed of a number of similar conduits, similarly arranged with the inner orifice of each in the most contracted section of its predecessor. The rear ends *a*, a_1, of the conduits e_2, e_3, have either a convergent or a divergent form, as the case may be. Under these conditions when the plane is in motion air is drawn into the tube *d* in the direction of the arrows *F'*. Since the tube is divergent the energy of the air-velocity is partly transformed in it into energy of compression. At the entrance to the combustion chamber *b* there is therefore an excess of pressure as compared with that of the air. Furthermore the air is drawn into the entrance orifice of the first conduit *e*, and its maximum expansion occurs in the narrowest section of this conduit. The expansion continues to increase up to the most contracted section of the following conduit e_1, and so on. Since the greatest expansion is thus produced in the conduit e_3, there results a powerful exhaust in the exit tube of the combustion chamber. In this manner we have by comparatively simple means an auto-compression device which is not only very effective but which meets the requirements of the situation very well.

The Mélot apparatus was first tried out in 1918, the apparatus developing about 30 horsepower for a relative velocity of 50 meters (a trifle more than 50 yards) per second. The thermodynamic yield was definitely better than that of the ordinary internal-combustion motor in present use. In the course of the tests this yield was brought up as high as 20 per cent, though the nozzles and pipes used had been constructed without previous study and were by no means of the most advantageous design. These tests were made with compressed air, the auto-compressing device being a later addition.

We are indebted to *La Science et la Vie* for the facts and especially for the drawing which is reproduced herewith.

A Wheel Alignment Indicator

IMPROPER alinement of the wheels of both passenger cars and trucks is costing the motoring public each year a needless expenditure of millions of dollars for tires. The man who is in the habit of noticing the car ahead knows that easily three out of four cars on the streets today have their wheels out of alinement due to bumping into the curbs, side thrust from deep ruts, car tracks, etc., improper adjustment of the tie rod, play in steering mechanism and wheel bearings and many other causes too numerous to mention.

Misalinement is without question the greatest preventable cause of tire wear. Its destructive effects are forcefully illustrated by the fact that if a 34-inch tire out of alinement one inch is run 3000 miles it will have been dragged sideways over 87 miles by the force of side thrust. No tires made can stand up under such excessive abuse which is now no longer excusable since it can be so easily remedied with the indicator.

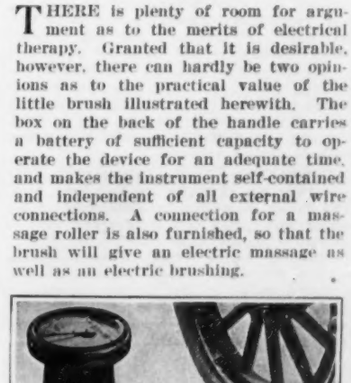
In order to measure the alinement of the front or rear wheel, you drive one of the wheels in question over the plate. The resistance between the wheels is relieved by the movable plate which, being mounted on two sets of roller bearings, is free to move inward or outward according as the wheel passes over it is toed in or out, while the other wheel rests on rigid ground. The movement of the plate is automatically communicated to hands on the dial which register to a fraction of an inch how much the wheels are toed in or out. The dial is calibrated for each size tire from 30 to 42 inches, insuring the correct measurement of tires of all sizes. Both solid and pneumatic tires can be measured with equal accuracy.

The important feature of the indicator lies in the claim that it is the only device on the market which registers the alinement of a car while the latter is actually in motion.

The electric brush that carries its own current

The Self-Contained Electric Brush

THERE is plenty of room for argument as to the merits of electrical therapy. Granted that it is desirable, however, there can hardly be two opinions as to the practical value of the little brush illustrated herewith. The box on the back of the handle carries a battery of sufficient capacity to operate the device for an adequate time, and makes the instrument self-contained and independent of all external wire connections. A connection for a massage roller is also furnished, so that the brush will give an electric massage as well as an electric brushing.



Getting a line on the wobbly wheel

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

FLYING CRUISER.—N. G. Cox, Livengood, Territory of Alaska. The invention particularly relates to flying machines adapted for service in warfare, and suitable for use at times, as vessels capable of floating in water. Among the objects is to provide a device with extensible wings so arranged that the inner surface may be increased or diminished, or may be virtually folded and thus rendered inactive, and to provide means whereby the propellers and rudders may be actuated and controlled by operators sitting at a distance therefrom.

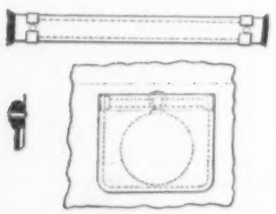
Electrical Devices

ELECTRIC FURNACE.—C. H. PRIESTLY, P. O. Box, 281, Elizabth, N. J. An object of the invention is to provide an electrical furnace in which may be produced extremely high temperature, and which furnace will be able to withstand increasing gas or air pressure incident to the generating of the temperature, and at the same time employ pressure producing elements for preventing vaporization of the materials to be melted.

MAGNETO POCKET LAMP.—G. M. BEAUDOT, address Wm. Platz, c/o Palatine Industrial Co., 111 5th Ave., New York, N. Y. The invention relates to a lamp in which the light is produced by a small magneto to which is imparted rotary movement. The device consists substantially in a push piece capable of taking a to-and-fro movment at right angles, the pressure causing successive impulses on the mechanism, thus imparting to the armature a continuous rotary movement.

Of General Interest

SAFETY WATCH POCKET PROTECTOR.—I. JURGIELEWICZ, Genl. Delivery, Los Angeles, Cal. This invention has for its object to provide a pocket protector for use in connection with pockets upon garments for the



SHOWING HOW THE STRIP IS CONSTRUCTED AND APPLIED

purpose of promoting the safety of the contents of the garment. The device comprises a metal spring strip with a piece of fabric folded and secured upon the strip and connected to the pocket edge either by sewing or rivets.

DUST BAG.—R. A. NORTON, 27 W. 24th St., New York, N. Y. Among the objects of this invention is to provide a dust bag designed for household use and arranged to permit of readily shaking off the dust from a dry mopping duster, and retain the dust without danger of its escaping back into the room. The bag may be readily carried from room to room, and may be temporarily supported from a door knob or similar support.

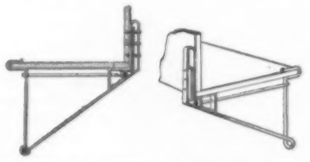
CONTAINER.—J. L. HAMILTON, 1981 Broadway, c/o King Tire Co., New York, N. Y. The invention relates to containers for fire extinguishing fluid and has for an object to provide a construction wherein the fluid is maintained sealed under ordinary circumstances, but which may be unsealed and the contents opened quickly, the body of the container being frictionally held against the lid in such manner as to be readily removed by a swinging lateral movement.

OIL CAN.—A. E. KAMMERITZ, 482 Franklin Ave., Hartford, Conn. The object is to provide a device of this character having means for detachably connecting the spout or nozzle with the body in such manner that it will be firmly locked to the body with a fluid tight joint, and wherein there will be no possibility of accidental dislodgment of the spout or nozzle.

FIGURE FOR BALLROOM DANCING PRACTICE.—S. E. FEIST, 1050 Broadway, Brooklyn, N. Y. This invention has for an object to provide a device which may be used by a pupil on a ballroom floor for practice. Another object is to provide an adjustable figure to properly coact with any sized student in learning to properly maneuver a partner when dancing on a ballroom floor.

INK BOTTLE.—MARY L. KAYSER, Tyler, Texas. This invention has reference more particularly to an ink bottle and holder, both of which are screw threaded so that the bottle may be removed from its holder for the purpose of cleaning or refilling, the holder being permanently fastened to a desk or other object. The device serves to prevent accidental displacement of the bottle.

BRACKET.—C. H. PASCHKE, 133 Baynes St., Buffalo, N. Y. The invention relates to brackets especially adapted for supporting a towel rack in spaced relation to the shelf. An



A SIDE ELEVATION AND PERSPECTIVE

object of this bracket is to provide means whereby shelves of different widths may be supported beneath a mirror or the like. The device is simple to apply and is neat in appearance and may be used either as a bracket for mirrors, walls or windows.

FOLDING TABLE.—G. J. KORN, 420 W. Missouri St., Kirksville, Mo. The invention has for its object to provide a table which may be folded into a body having the form and approximately the dimensions of a suit case or which may be opened out into a flat top table, wherein the elements are securely braced so that there is no possibility of collapse.

WINDOW GUARD.—B. C. PETTERON, 169 Cedar Ave., Memphis, Tenn. An object of the invention is to provide an automatically opening curtain of a slatted type for use in connection with store or display windows and normally controlled and held in a practically concealed position together with means for automatically locking the same in lower effective position covering the window space.

RECEIVING ACCOUNT CHECK.—J. RIIS, Box 46, Castlewood, S. Dak. The invention relates more particularly to check books or pads for produce receiving stations such as creameries or other receiving stations, where many checks are written and speed and accuracy are essential, the object being to simplify the payment of accounts, issuance of receipts and entry of receipts, performing these three operations practically as one.

GLOVE FINGER SUPPORTING TUBE.—D. BAUM, c/o The Livermore, Falls Glove Co., Livermore Falls, Me. More particularly this invention relates to a tube which is designed to support and facilitate the turning of the finger, and hence, the turning of the glove. An object is to provide a device which is adapted for use in connection with cotton, leather or combined cotton and leather gloves, having flexible fingers.

SHELL FISH SCRAPER.—C. S. PRICE, 1643 Champa St., Denver Colo. This invention is more particularly designed as an article for table use to accompany the usual knife and fork and to take the place of the so-called "oyster fork." The scraper loosens and

A GENERAL VIEW OF THE SCRAPER

scrapes clean the meat adhering to the inside of claw parts or shells on to the service plate; it is not intended to eat with; it can be conveniently used in connection with lobsters and shell fish generally. The handle may be made to match the various silverware services.

TOUPEE AND WIG RETAINER.—J. C. TAPSCOTT, Box 1046, El Paso, Texas. This invention relates to the manner in which a wig or toupee is retained in place on the head, the prime object is to provide an arrangement which will avoid the use of double faced adhesives for this purpose by substituting a single faced adhesive whose adhesive face is turned inwardly for engaging the scalp, and which is provided with spurs on the upper surface for retaining the wig.

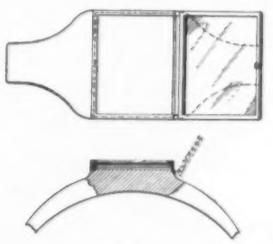
REFRIGERATOR.—M. COHEN, c/o Mrs. Weinstein, 636 E. 13th St., New York, N. Y. This invention relates to refrigerators of the general type employed in households, small stores, and the like, more especially the invention relates to a refrigerator in which the drip from the ice is received in a tank within the refrigerator that the cooling action of the water and the water itself may be utilized.

DUPLEX PICTURE.—F. MEEKS, 143 S. Broadway, Los Angles, Cal. An object of the invention is to provide a duplex picture frame arranged with a glass or transparent parcel and provided with a space between the picture and the panel adapted to accommodate sand or other movable material therebetween and to prevent its escape, and with means for suspending the picture in inverted position so that different scenes will be independntlye exhibited.

KEY RING CHAIN.—C. H. OTIS, 62 Hawthorne St., Hartford, Conn. An object of this invention is to provide a chain construction and coupling means for holding the ends of the chain together. A further object is to provide a coupling device which is primarily adapted for use on key ring chains, but which can be conveniently used on various types of chains or other articles.

CUFF BUTTON.—M. J. SULLIVAN, P. O. Box 197, Holyoke, Mass. The object of this invention is to provide a cuff button which is extremely simple in construction, in which a separable connection between the parts is effected, which will permit of the ready detachment of one of the sections from the other, although at the same time holding these sections against any accidental detachment.

FINGER RING AND PHOTO-MOUNT FOR THE SAME.—NANNIE K. HUNT, Petroleum, Ky. The invention relates to an ornamental finger ring and has for its object to provide a device to be worn in the usual way, and



SHOWING A PLAN VIEW AND SECTION

provided at the top with a photo-receiving recess and a transparent cover for the same. The device comprises a finger embracing band having an enlarged top portion as in a signet ring, and a cover comprising a rectangular frame, and a glass panel carried by the frame.

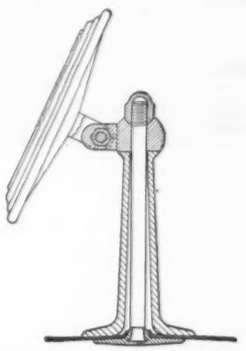
HAT HOLDER.—J. S. ALLEN, 229 W. 101st St., New York, N. Y. Among the objects of the invention is to provide a device which is designed to efficiently support a hat in the top of an automobile and the like, and which can be easily and quickly placed in operation or removed therefrom. The device can be manufactured and sold at an extremely low price.

ATTACHMENT FOR TAPE MEASURE.—G. A. BRANDENBURG, 1167 Champa St., Denver, Colo. The invention is more particularly intended for use in connection with a form of tape, arranged to wind within a case. The general object is to provide means at the end of the tape adapted to be employed for securing the same by pinning it down or causing it to grip a fixed object, thereby making it unnecessary for a second person to be present to hold the line at one end.

COMBINED SHAVING MIRROR AND CABINET.—C. LICHTENBERG, 1137 Green Ave., Brooklyn, N. Y. The object of the invention is to provide a mirror with a sliding cabinet behind. The mirror may be moved into various positions to adequately reflect light from any source. The cabinet may be opened either side of the mirror and can be used regardless of the position of the mirror. The cabinet is intended for toilet articles, the mirror being particularly adapted for shaving and adjusting the hair.

AIR DRAFT MOTOR.—G. BERRY, Box 365, Checotah, Okla. Among the objects of the invention is to provide a portable air motor, being very light it can be carried about and set up wherever required for the purpose of running fans, ventilating rooms, etc. A further object is to provide a draft motor with a long draft tube or flue, arranged to be supported in any suitable manner while the device is in operation, but which can be telescoped so as to make the apparatus portable.

HOLDER FOR MIRRORS AND OTHER ARTICLES.—H. A. DIEGTID, 975 Atlantic Ave., Brooklyn, N. Y. The general object of the invention is to provide a holder embodying a



A PARTLY SECTIONAL SIDE ELEVATION OF HOLDER, MIRROR POSITIONED THEREON

standard and clamping means in coaction with the standard to clamp the holder in position on a fender or support and constituting also means to clamp in place on the standard a bracket for holding a mirror or other article.

FLYTRAP.—W. S. WALLACE, address L. C. Wallace, 91 St. Marks Ave., Brooklyn, N. Y. An object of this invention is to provide a fly trap arranged to insure a proper transfer of the flies or other insects from the bait to the revolving cage without crushing the insects on the bait and thus spoiling the latter. Another object is to permit of conveniently removing the cage from the trap without danger of the captured flies escaping.

Hardware and Tools

TWEEZERS.—E. H. METCALF, Marlboro, N. H. An object of the invention is to provide a construction of tweezer, cut from a single metal blank forming a pair of spring jaws movable toward and away from each other by means of a removable finger operating lever for controlling the operation of the jaws. A further object is to provide a tweezer which can be manufactured and sold at a low price.

GATE HINGE.—R. P. BILLICAN, Natchez, Miss. Among the objects of the invention is to so construct the hinges used upon a gate that the gate will always be properly closed. The device comprises a hinge connecting the fence and gate, and includes a hinge pin, a pulley mounted on the hinge pin, a coiled spring connecting the fence and gate and means associated with the fence to regulate the tension on the spring.

Machines and Mechanical Devices

ROD SOCKET OR COUPLING.—J. A. DAY, Oilfields, Cal. The principal object of this invention is to produce a rod socket which may be lowered into an oil well for the purpose of recovering a broken sucker rod, which may be lost within the well. Another object is to produce a rod socket which is simple and which may be operated by an inexperienced person.

BALL BEARING.—W. H. TEETSOW, 154 Nassau St., New York, N. Y. The particular object is to provide a type of ball bearing capable of taking radial loads, combined radial and thrust loads, and end thrust loads impressed from either direction to enable the use of the bearing on all types of machinery where it becomes necessary to provide bearing facilities for a variety of load conditions.

OIL WELL SCREEN AND LINER CLEANER.—J. R. HALL, Winfield, La. This invention has for its object to provide a device by means of which the screen and liner of a well may be easily and efficiently cleaned from within by means of jets of water driven through the screen, and wherein means is also provided for dressing the inside of the screen to remove burs left in the formation of the same.

CLUTCH.—W. E. STOY, Box 1066, Juneau, Territory of Alaska. The object of this inven-

(*Continued on page 106*)

The Radio Compass and Navigation

(*Continued from page 89*)

navigator of any vessel fitted with the radio compass can then take definite bearings to learn the position of his ship even though his guiding aids are unseen.

At the start, trouble was encountered when two or more stations were generating signals at the same time. When the receiving apparatus, in picking up wireless waves from one lighthouse, had been rotated so as to give minimum audibility, *i.e.*, had been swung at right angles to the waves of the transmitting set, not infrequently that minimum was "drowned" or confused by the arrival of a louder signal from another dispatching point. This difficulty has now been overcome in a simple manner. For instance, in approaching the Port of New York, Ambrose Channel and Fire Island light vessels and the light station at Sea Girt, New Jersey, propagate distinctive signals. The Ambrose Channel craft sends one dash periodically; the Fire Island ship uses a group of two dashes; while Sea Girt employs a group of three dashes. By reason of these variations, which for the nonce are substituted for visible flashes of white or colored lights, the mariner off shore can establish definitely the direction and identity of the source of the radio waves and thus secure a bearing in thick weather. If the navigator has two or more such aids the chance of error in fixing the position of his ship is reduced proportionately, the intersecting lines forming angles that check one another when referred to his chart.

From what has been said of the basic phenomenon involved in the use of the radio compass, it may be asked by the uninformed, "How does the mariner discover the geographical situation of the sending station, for, even though the receiving apparatus discloses the line on which the station lies, he may still be at a loss as to its location east or west of him, for instance? This initial shortcoming of the radio compass for service afloat has been disposed of by equipping the instrument with a unidirectional feature. This is a simple adjunct which renders it possible to pick up a signal's maximum audibility at only one point and that when the recording hand is pointed right at the generating station. Where radio compasses are set up ashore the unidirectional feature is not required, because the observer knows that signals from shipping must, of necessity, originate off the coast.

The present compass was invented by Mr. F. A. Kolster of the Bureau of Standards, and its employment was suggested by him to the Bureau of Lighthouses in 1916. Some experiments were made early in 1917 with the system, but our entry into the World War interrupted further tests. Two years later the investigations were resumed, and, as a result of these and improvements made because of them, there has since been evolved apparatus of a highly efficient type. The "coil aerial" consists of ten turns of high-frequency wire spaced one centimeter apart and wound around a rotatable frame approximately four feet square. Associated with this antenna there is a variable tuning condenser which is connected across the terminals of the compass coil. The primary of the air-core transformer is connected to the terminals of a condenser by means of slip rings. The amplifier is then connected to the terminals of the secondary coil of the transformer.

The coil aerial is mounted upon a vertical spindle fitted with a pointer, and a graduated circle beneath that index determines the angle of the coil with respect to a known direction. In the installations which have been made aboard lighthouse tenders, the coil aerial is on the roof of the pilot house. The spindle extends through the roof and is equipped with a hand wheel for rotating the coil. The lower end of the spindle terminates directly above the center of a standard ship's binnacle, and carries a pointer so arranged that the position of the coil may be read directly upon the compass card, thus giving the magnetic bearing of the radio-signal station at a glance as soon as the minimum point of signal audibility is reached.

The transmitting apparatus, whether located at a lighthouse or placed aboard a lightship, is of a commercial type, simple and rugged in construction, and of about 1 kilowatt power. In addition, each set has a special automatic motor-driven timing switch for producing the desired signal at regular intervals. The antennæ at sending stations are the same as those used for ordinary radio communication. The wave length at present employed is of 1000 meters, the existing international standard for such signals, and the range of effectiveness varies from 30 to 100 miles, depending upon the sensitiveness of the receiving apparatus.

Where vessels are guided in thick weather by means of radio compasses set up on shore, a group of land stations cooperating can help only one ship at a time; and the coordination of the readings of several of these stations takes some while. By the newer system, any boat possessing a radio compass installation can make her own determinations of her position as often as she likes when within the receiving range of automatic and continuously propagated signals emanating from one or more lighthouses, etc. The operation of the radio fog-signaling apparatus requires no additional personnel at lighthouses or lightships. It is a matter of only a moment to bring the wireless-wave generating mechanism into action.

It is the intention of the Lighthouse Service, after a suitable trial period of the present group of stations in the vicinity of the Port of New York, to install kindred groups at the approaches of other important harbors on the Atlantic and the Pacific coasts as well as along the shores of the Great Lakes.

Depth Bombing from the Air

(*Continued from page 93*)

had fallen clear, there appeared all around the waterline at the stern of the vessel and well up toward amidships, a white line of foam boiling around the vessel, broken occasionally on both sides of the stern by bursts of foaming water.

There was but one interpretation of this phenomenon. It meant that not only the port side, but also much of the bottom of the ship must have been broken in and that this disturbance was caused by the escape of vast volumes of air from the wrecked underbody as the water rushed in. Immediately, the great ship began to list to port, turning steadily over as the afterbody of the ship submerged. When the bow of the vessel struck the bottom some 300 or 350 feet below the sinking was arrested, and the ship seemed to hang for a few moments before the stern took the final plunge and disappeared. Just after she had gone down, the Handley-Page bomber flew over the circular patch of still foaming water, and dropped the last of the 2000-pound bombs, thus sounding taps over this marine burial.

Don't Draw Wrong Conclusions

It is not to be wondered at if, to the lay mind, this majestic spectacle should have had but one immediate meaning, and express itself in the all-too-common phrase: "That seals the doom of big battleship construction." As a matter of fact, it means nothing of the kind. Naval and military men knew perfectly well that 1000 pounds of TNT detonated near the side of such a ship as the "Ostfriesland" would be pretty certain to send her down. Whether it would have done the same to the flagship "Pennsylvania," which floated not far away, is a mooted question. Subdivision has made wonderful strides in the last ten years. That bomb might possibly have sunk the "Pennsylvania." It is certain that it would have put her out of action for the time being.

The most important part of your car is the little Transformer, which cures the uneven, missing, jerky motor and makes self starters live up to their name. "VKCO"

Van Kerr Transformers

Decrease gasoline consumption—give greater power—reduce carbon deposits. They can be attached in a few minutes, and from that time on you will have a sweet, smoothly running motor which starts easily even in zero weather.

Does Your Motor Pump Oil? Don't Worry!

Van Kerr Transformers cure the troubles which are due to this condition. Their patented, fireproof construction allows the current of electricity to be broken in the open air without danger of igniting any vapors under the hood. The more combustible spark so produced, burns every particle of oil and gas, giving greater power and leaving no carbon. The Van Kerr method of ignition eliminates the necessity for reboring cylinders and installing new piston rings and instantly removes the difficulty caused by motors pumping oil. For pleasure cars, tractors, motorcycles, and gas engines.

We Will Send You a Set of Transformers

Attach them yourself. All you need is two minutes and a pair of pliers.

by parcel post. Write us today and tell us your dealer's name and the kind of car you drive. Send no money. Simply pay the postman $2.00 for a four-cylinder set or $2.50 for a six-cylinder set. Use them ten days and if you are not satisfied that they do all we say they will, return them and you will get your money back.

The Van Kerr Co., Dept. 691, 3160 N. Clark St., Chicago

Over 100,000 satisfied customers are using Van Kerr Transformers

The dealer offers with pride

WHITING-ADAMS BRUSHES

They always have been his best sellers and strong helpers for his prosperity. They have satisfied brush users for over a century

Send for Illustrated Literature

The Guarantee of Quality

JOHN L. WHITING-J. J. ADAMS CO., Boston, U.S.A.

Brush Manufacturers for Over 112 Years and the Largest in the World

Experimental and Model Work

Fine Instruments and Fine Machinery. Inventions Developed. Special Tools, Dies, Gear Cutting, Etc.

HENRY ZUHR, 489-93 Broome St., New York City

INVENTORS

Models *Experimental Work*

Are you looking for a reliable firm to assist you in developing that idea that you just can't work out? Consult us—With our staff of expert engineers and thoroughly equipped experimental machine shop, we can develop any proposition for you, mechanical or electrical, and MAKE IT WORK.

We develop, simplify and perfect inventions, make them commercially possible, and build working models. We design and build special automatic labor-saving machinery. All business strictly confidential and protection guaranteed.

ELK MFG. CO., Inc.

1926B Broadway New York

UNISOL

Reg. U. S. Pat. Off.

CORRECTS undesirable boiler feedwater conditions

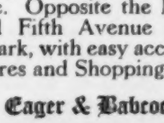
UNISOL is a preparation that IS for boilers that ARE scaled, corroded, pitted, etc. The longer used, the more its value is appreciated.

Pamphlet on request. Money back guarantee

UNISOL MFG. CO., Jersey City, N.J.

LEARN WATCHWORK JEWELRY WORK DAN ENGRAVING

A fine trade commanding a good salary and your services always in demand or you can start in business for yourself. At



Formerly Parsons Horological Institute

BRADLEY INSTITUTE

The greatest school for watchmakers in the world. Address, Horological Department H-Peoria, Ill., for catalogue of information. Also teach Optics and Instrument Repair.

Fourteen East Sixtieth Street

New York City

An Exclusive Residential Hotel affording the Dignity and Elegance of a Private Residence. Opposite the Metropolitan Club and Fifth Avenue entrance to Central Park, with easy access to Clubs, Theatres and Shopping centres

Eager & Babcock

RECENTLY PATENTED INVENTIONS

(Continued from page 104)

tion is to provide a reversible frictional clutch for use in mobile or stationary machinery, wherein the speed forward and backward may be obtained by merely moving the clutch operating mechanism in opposite directions. When the operating parts of the clutch are in neutral position, the driving shaft rotates freely without imparting motion to the driven shaft.

Prime Movers and Their Accessories

TESTING DEVICE FOR IGNITION SYSTEM.—H. F. MAGUIRE, 168 East End Ave., New York, N. Y. The invention has reference more particularly to a testing device for jump spark ignition systems which are commonly used for the firing of explosive charge of internal combustion engines. The device is especially applicable to an ignition system which employs a series of spark coils, one of which being provided for each cylinder of the engine.

GAS GENERATOR.—M. BOISEN, 1511 Camp St., Sandusky, Ohio. The invention relates to an apparatus for decomposing water so as to generate oxygen and hydrogen and direct these gases into separate tanks, and afterward commingled in the desired proportions for use, the use being primarily intended for internal combustion engines. The decomposing tank and the operation of the generator are automatic, the pressure in the tanks controlling the level of water so as to stop and start decomposing automatically.

Railways and Their Accessories

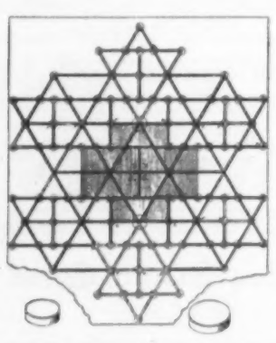
COMBINATION LOCK AND CONTROLLER FOR SIDE DOORS OF BOX CARS.—F. H. WARD, Washington, D. C. The object of the invention is to provide a construction in which the doors of the car are constrained to corresponding movement whereby when one of the doors is secured in desired position the other is automatically secured in corresponding position and in which manipulation of the doors by an unauthorized person is effectively precluded. The device is simple and durable, and inexpensive to manufacture.

FREIGHT CAR DOOR.—L. W. MANHEIM, Box 132, Camden, S. C. An object of the invention is to provide a door construction which will greatly facilitate the loading and unloading of the car. A further object is to provide side and end doors hinged at their lower edge and adapted to swing outwardly and to provide means for controlling the position of the doors so that they may be used either for platforms or runways.

SPIKE PULLER.—J. B. ERICKSON, address C. D. Symonds, Iron Mountain, Mich. The invention relates to a device which facilitates the removal of spikes and which employs a lever positioned parallel with the the rail and operates to remove the spike from either side of a rail. The device is especially adapted for use on bridges, trestles, and elevator work where it is difficult to employ the ordinary type of spike puller.

Pertaining to Recreation

GAME.—C. B. MULLINS, Jr., R.F.D. No. 3, Oklahoma City, Okla. Among the objects is to provide a game of that class which comprises a checker board and a plurality of playing pieces. An object is the provision of



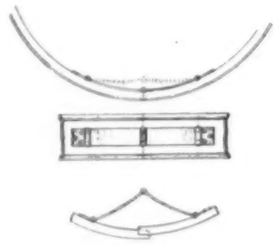
A PLAN VIEW OF THE BOARD AND THE GAME PIECES

a game which will require two groups of players with the players of each group operating a plurality of game pieces to combat their skill in defeating the other group.

VELOCIPEDE.—C. E. HORNIG, 309 Market St., Perth Amboy, N. J. An object of the invention is to provide a velocipede which is propelled by means of a crank shaft constituting the rear axle and to which motion is imparted by the movement of the body and legs of the rider. The action of the propulsion requires the rider to simulate the motions which occur during horseback riding.

Pertaining to Vehicles

DEMOUNTABLE TIRE RIM.—L. D. ALLEN, 2273 Pine St., San Francisco, Cal. An object of the invention is to provide a practical and convenient manner for removing and applying a pneumatic tire to the rim. A further object is to so construct the rim that a tire may be removed from and applied thereto without the use of tools or an undue amount of effort.



A SIDE ELEVATION ILLUSTRATING THE APPLICATION OF THE DEVICE

SHOCK ABSORBER.—P. DU FORD, address W. E. Lees, Ontario, Oregon. An object of the invention is the provision of shock absorbing means for use in connection with or without the ordinary leaf spring, either semi-elliptic or full elliptic, whereby to increase the range of relative movement of the spring controlled parts without curtailing or impairing the normal function and operation of the leaf spring where present. The invention will automatically take care of the variation of the load.

TRANSMISSION BAND.—H. F. HONS, Jr., San Francisco, Cal. The invention has reference more particularly to a so-called straining ear for transmission bands as commonly used in Ford automobiles. The device is applicable for use in connection with either one of the three rotating drums, namely, the low speed, reverse, and brake employed in the planetary transmission system.

SHACKLE.—G. B. ROBERTSON, address O. E. Cain, Cheshire House Block, Keene, N. H. Among the objects of the invention is to provide a shackle primarily for connecting one vehicle to another, but not necessarily limited to this adaption, and by means of which any possibility of an accidental disconnecting of these elements is reduced to a minimum. The parts may be coupled with great facility, by certain operating means at a point relatively remote from the shackle itself.

GRADOMETER.—S. W. HALL, c/o S. A. Public Serv. Co., 305 E. Houston St., San Antonio, Tex. It is a purpose of the invention to provide a gradometer which is particularly adapted for use on motor vehicles, and which will accurately indicate under the most varying and unstable conditions the inclination and declination at which any moving body is traveling.

DEMOUNTABLE RIM.—L. U. STENGER and R. SUMMERFIELD, Canyonville, Ore. The object is to provide a rim which can be quickly attached to, or removed from, the felly of a wheel, which will involve no change in the size or form or balance of the wheels, in which the rim can be changed without changing the locking device therefor, which will take up the natural wear and which will insure alignment of the tire.

COMBINATION LOCK FOR AUTOMOBILES.—A. H. BUCKLEY, 58 W. Ontario St., Chicago, Ill. Among the objects is to provide a device by means of which an auxiliary valve in the fuel feed line of an automobile engine may be locked in position so as to shut off the flow of fuel, and thereby prevent the operation of the engine. A further object is to provide a device in which the movement of a single lever in one direction will instantly bring the auxiliary valve into locked position.

OVERHEAD VALVE.—W. H. and P. M. PAYNE, c/o W. E. Moore Co., 706 Union Bank Bldg., Pittsburgh, Pa. This invention relates more particularly to a valve for automobiles, having as its object the elimination of rattling and noisy contact between the valve operating parts of the overhead valves. The purpose is to eliminate the metal to metal contact and provide means for holding the rocker arm in yielding engagement with the valve stem at all times.

DUMPING TRUCK.—F. M. GOOSSEN, c/o Buller Coupling Co., Hillsboro, Kans. This invention has for its object to provide a body which is suited for use with motor trucks or animal-drawn vehicles, and to provide for locking the body in horizontal position on the truck. A further object is to provide a construction of dumping truck which will be sturdy and durable, simple, and easily manually operated.

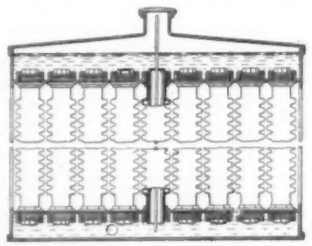
SEAT FOR VEHICLES OR THE LIKE.—G. V. BARNES, Alameda, Cal. The invention relates to a seat mounting or suspension. The prime object is to provide means for absorbing, so to speak, lateral jolts and shocks experienced in a vehicle such as an automobile which are not taken up or absorbed by the springs of the vehicle.

AUTOMOBILE PLATE AND HOLDER.—J. BILLINGS, 13 Park Row, New York, N. Y. The invention relates to an attachment in the nature of a "stop thief" device, and is designed to deter the unauthorized use of the vehicle. The device is provided with means for attaching to a wind shield a legend such as "Watched," and it is so arranged that the sign may indicate to the police or others that any use of the vehicle is unauthorized. An individual cover for each particular legend holder is provided so that it cannot be concealed except by the owner.

AUTOMOBILE WHEEL LOCKING DEVICE.—L. E. TRIMM, 465 E. 29th St., Brooklyn, N. Y. An object of the invention is to provide a construction in which a large device is utilized as means for preventing the rotation of one or more wheels. The device is provided with two flat sides and a clamping means so that it may act as a skid in case it is attempted to move the automobile.

TRANSMISSION GEAR.—C. BEARENS, 106 Bank St., New York, N. Y. The general object is to provide an automatic gear shift, whereby if in starting, going up hill, or otherwise running under heavy load and direct drive, should the speed be too high for starting or overcoming the resistance without shock, the gearing will be automatically thrown out of high gear and into lower gear to start or continue under the latter.

RADIATOR.—A. NEBEL, 794 Knickerbocker Ave., New York, N. Y. The invention relates to liquid cooling devices, and is particularly adapted for use as a radiator for automobiles, but may be used wherever it is desirable to



A VIEW PARTLY IN SECTION, SHOWING THE ARRANGEMENT OF TUBES

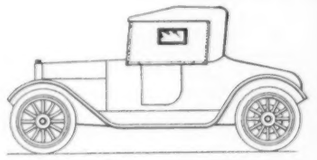
cool a circulating liquid. Among the objects is to provide a radiator having its parts so constructed as to bring the circulating fluid in contact with a large exposed surface whereby the liquid may be effectively cooled, in a limited space.

HEADLIGHT.—H. F. HAMMOND, address N. A. Siraco, 116 Main St., Whitehall, N. Y. An object of the invention is to provide an attachment for ordinary headlights which will operate to prevent glare but allow full road illumination. A further object is to provide a device which is of transparent colored material so as to color the light rays which are thrown upwardly and at the same time permit a full glare of uncolored light on the road.

DIRECTION INDICATING APPARATUS FOR AUTOMOBILES.—L. W. SIMMONS, Forest Lake, Minn. Among the objects is to provide means embodying a signal device arranged at the front or rear of an automobile for indicating the direction in which the automobile is to be turned, such means being actuated by elements arranged on the dash or other conveniently located portion of the car. The device is manually thrown into operation and automatically returns to the normal condition.

GREASE GUN.—J. OWENS, 1057 Jefferson St., N. W., Washington, D. C. This invention relates more particularly to portable hand grease guns whose most common function is the feeding of grease lubricant to the transmission and differential casings as well as the universal joints of automobiles. This device is characterized by its simplicity, strength and durability.

CURTAIN WINDOW.—C. B. PECK, Batavia, N. Y. The invention especially relates to windows which are adapted to be used in the side curtains and rear covering of automobiles; an object is to provide a detachable glass window which will take the place of the

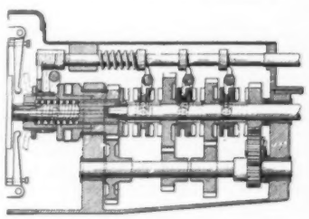


A VIEW OF AUTOMOBILE WITH DEVICE APPLIED

flexible material now in general use. A further object is to provide a window which may be inserted in any ordinary automobile curtain, which will be durable, of light weight, and readily replaced.

PNEUMATIC TIRE.—J. GUAGLIARDO, R.F.D., Box 16, Hammond, La. The object is to provide a construction which will obviate the necessity of the inner tubes and which, while it will not eliminate puncture, will at least avoid the necessity of immediate change of tires and will permit the user to proceed for a time with little discomfort and without danger of destruction of the tire.

TRANSMISSION GEARING.—W. S. CUNNINGHAM, 2027 Elizabeth St., Shreveport, La. An object of the invention is to provide a transmission gearing in which the gears are always in mesh, and there is no danger of stripping of gears by the shifting of the



A VIEW IN LONGITUDINAL SECTION

clutches. The operation is by an arrangement of clutches controlled by foot levers very much as the foot levers of an ordinary Ford control with the exception that an additional lever is provided to give an intermediate speed.

CONVERTIBLE AUTOMOBILE TOP.—B. B. ELLERBECK, 156 6th St., S. W., Washington, D. C. The invention relates more particularly to rigid tops, especially for two-passenger vehicles; the object is to provide an arrangement whereby the top with or without sliding, swinging, or otherwise mounted windows may be shifted bodily on connections with the vehicle into and out of effective position from the vehicle seat, the top in inoperative position being located rearwardly of the seat.

Designs

DESIGN FOR A MIXING AND STIRRING DEVICE.—M. BLACK, 390 Putnam Ave., Brooklyn, N. Y.

DESIGN FOR A DIRECTION INDICATOR.—IVY D. HOWELL, 12 Church St., Ballston Spa, N. Y.

DESIGN FOR A SIFTER TOP FOR A POWDER CAN OR SIMILAR RECEPTACLE.—C. S. HUMPHREY, c/o Manhattan Can Co., Bush Terminal, No. 10, Brooklyn, N. Y.

DESIGN FOR A KNIFE AND FORK CLEANER.—J. J. GOTTFRIED, 930 E. 15th St., Brooklyn, N. Y.

DESIGN FOR A RECEPTACLE PLUG.—P. R. COLLIER, 202 Sumac St., Wissahickon, Philadelphia, Pa.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & CO., Solicitors of Patents
Woolworth Building, NEW YORK
Tower Building, CHICAGO, ILL.
Scientific American Bldg., WASHINGTON, D. C.
Hobart Building, SAN FRANCISCO, CAL.

LEGAL NOTICES

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

SCIENTIFIC AMERICAN

Contains Patent Office Notes, Decisions of interest to inventors—and particulars of recently patented inventions.

MUNN & CO., SOLICITORS OF PATENTS

Woolworth Building, NEW YORK
Tower Building, CHICAGO, ILL.
Scientific American Building, WASHINGTON, D. C.
Hobart Building, SAN FRANCISCO, CAL.

Annual Subscription Rates
Scientific American Publications

Scientific American (established 1845) one year $6.00
Scientific American Monthly (established 1876) one year $7.00
Postage prepaid in United States and possessions, Mexico, Cuba and Panama.

Foreign Postage

Scientific American $1.50 per year additional.
Scientific American Monthly 72c per year additional.

Canadian Postage

Scientific American 75c per year additional.
Scientific American Monthly 36c per year additional.
The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check.

Classified Advertisements

Advertising in this column is $1.00 a line. No less than five nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AGENTS WANTED

AGENTS, $60 to $200 a week. Free samples. Gold Sign Letters for Store and Office Windows. Anyone can do it. Big demand. Liberal offer to general agents. Metallic Letter Co., 431X N. Clark St., Chicago.

BUSINESS OPPORTUNITY

WOULD like to get in touch with Aeroplane Manufacturers or others who might become interested and are financially able to conduct Helicopter-Aeroplane experiments. Guaranteed to be both interesting and practical. Address E. M. Blacksher, P.O. Box 338, Brewton, Ala.

BUSINESS OPPORTUNITY

YOU CAN have a business profession of your own and earn big income in service fees. A new system of foot correction; readily learned by anyone at home in a few weeks. Easy terms for training; openings everywhere with all the trade you can attend to. No capital required or goods to buy, no agency or soliciting. Address Stephenson Laboratories 23 Back Bay, Boston, Mass.

BUSINESS OPPORTUNITY

SUBSTANTIAL manufacturing corporation wants capable men to establish branch and manage salesmen, $30 to $2000 necessary. Will allow expenses to Baltimore as explained. Address, Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

FOREIGN STAMPS

55 DIFFERENT STAMPS, including China, Japan, French Colonies, etc., given to applicants for our high grade approval selections. Send references and 2c stamp to the EDGEWOOD STAMP CO., Dept. G, Mfoldr, Conn.

WANTED

MANUFACTURING rights on metal articles. Also metal stampings and model work on contract. We are ideally located and equipped to develop patents. Meyers Company, Box 263, Bedford, Indiana.

You can be quickly cured, if you

STAMMER

Send 10 cents for 288-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering 20 yrs. **B. N. Bogue, 2309 Bogue Bldg., 1147 N. Ill. St., Indianapolis.**

South Dakota State School of Mines

Rapid City, South Dakota

Has just closed the best year in its history. Few institutions have at their doorway such a wonderful outdoor laboratory as the Black Hills region.

Degrees are granted in Civil, Electrical, Mining, and Metallurgical Engineering.

Expenses are low and much attention is given the individual student. Write and let us tell you more about the advantages here provided. For catalog and book of views address, The President.

Dead Men's Fingers

(*Continued from page 94*)

quite similar to the elegant stinkhorn in color and structure, but is club-shaped, tapering toward the base rather than toward the apex, and is much rarer, occuring in old fields in clay soil practically destitute of leaf-mold or in grassy ground partly shaded.

The only European species of this genus, *Mutinus caninus*, has a slender, cylindric stem which tapers in neither direction, and a small cap that is set off rather sharply from the stem, differing in this respect quite decidedly from the elegant stinkhorn, although resembling it in color and general form. It has been reported a few times from the United States, but I have seen no American specimens. It would give me much pleasure to receive some. This species has a very faint odor, and the stem sometimes varies to white. All the species of Mutinus readily lose the greenish slime containing the spores since it is eagerly devoured by flies and easily washed away by light rains.

The branched stinkhorn, *Lysurus borealis*, grows solitary or clustered, 10-12 centimeters high; stem white, divided above usually into six but sometimes five or seven, narrowly lanceolate hollow arms, which are incurved above, with pale flesh colored backs traversed their entire length by a shallow furrow; cavity of the stem nearly closed at the base of the arms by a diaphragm through which there is an opening upward into a closed chamber with a dome-shaped wall; gleba supported on the dome and closely embraced by the arms; spores oblong, white; eggs clustered, 3.5-4 centimeters in diameter.

The odor of the mature plant is very vile and penetrating at close range, somewhat resembling that of fresh guano, but it is not pervading like that of the veiled stinkhorn, for example, and also lacks the "faint" quality of most stinkhorns. The slime containing the odor is inside the five rays and oozes through the spaces between them as they spread slightly. The "eggs" are in clusters of three or four or more, and are about 3.5-4 centimeters in diameter. A section of an "egg" shows the conspicuous cap enclosed by the thin, white inner wall, while the stem is much compressed until the elongation begins which pushes the cap rapidly into the air.

According to Mr. C. G. Lloyd, whose publications on this group have furnished some of the illustrations here used, the branched stinkhorn may have been introduced from Australia or South America, where species occur that greatly resemble it. Both in Europe and in the United States it seems to have appeared rather recently in gardens, fields and other cultivated places. Dr. Peck found it in an asparagus bed, while it was collected last October at the New York Botanical Garden in a gladiolus bed. Several collections have been made in Massachusetts and Connecticut in tomato and potato fields, and one in a lawn newly plowed and seeded. Professor Beardslee found an acre of it in Ohio, where heavy sod had been turned and allowed to decay. It had not been seen there before and its sudden appearance in such profusion was rather difficult to explain.

The Last Word in Power Houses

(*Continued from page 98*)

and into the main channel of the river before any of it reaches the intake again. By that time it is thoroughly cooled.

The coal unloading tower also has points of interest. Here, also, the engineers faced the necessity of reducing weight in order to permit the use of concrete. A great deal of height and weight was eliminated in this instance by using a conveyor belt which carries the coal up an incline and distributes it to the bunkers within the plant. The fuel is lifted from the barges by means of a crane hoist of standard design and dropped [illegible] to a magnetic separator. From there it passes into the crusher and thence to the belt.

In all large generating stations, the electric currents and voltages are of such magnitude, and the necessity of centralized control is so imperative it would be impractical to operate the switches by hand. For these reasons they are equipped with electric motors which open and close them and which are all controlled from a central control switchboard located in the operating room.

The pipe room, referred to above as a special feature of the electrical equipment, gets its name from the fact that it is the terminus of all the iron pipe conduits through which the wires from the central control switchboard are led out to the small motors on the high voltage switches. Through other pipes terminating in this room also pass the wires leading to the instruments which are mounted on an instrument board located in the central operating room directly in back of the control switch board, and which tell the operator at a glance what his machines are producing and to what substations the energy is being transmitted.

The layman hearing this room described and seeing it is surprised that no one ever thought of it before. In conception, the idea is simplicity itself.

In plants where no such room is provided the pipes are terminated in a trough depressed in the floor of the operating room in back of the switch boards. This means that there is a great mass of wires in the trough, which increases the difficulty of tracing faults in the wiring and in the event of one wire burning out, the fire may easily be transmitted to the wires controlling other circuits, resulting in interruptions to service and delay in restoring it, all of which is fatal to the interests of the power company.

The Philadelphia Electric Company while studying ways and means of eliminating these delays and fire risks and thus assuring the company's ideal of continuous service, has substituted its pipe room for the trough back of the switchboards.

The pipes are arranged to come up out of the floor of the pipe room directly under the respective switchboard panel controlling the circuit to which they apply. The wires of each circuit are separated from those of other circuits throughout so that a fault developing in the control wiring of one circuit cannot be transmitted to that of any other circuit. For convenience in tracing defects in the wiring and in testing switch board instruments, each wire passes through a fuse or cut-out block mounted on a terminal board in the pipe room and labeled so that the electrician can identify each wire without delay.

It is altogether probable that this system of arranging control wiring will become standard for large power houses throughout the country. It was first installed by the Philadelphia Electric Company in its Chester Station, which transmits electrical energy to Philadelphia at 66,000 volts pressure over an aerial line on steel towers. This plant was completed in 1918, in which year it was considered the last word in the production of electricity. It is equipped with two of the same size and type turbo-generators as those being installed in the Delaware Station.

As indicated, however, there have been several new developments in this station not to be found in any other power plants. The boilers are of the same type and rating as installed in the Chester plant. But in order to provide for the possible installation of oil-burning equipment if that should become necessary later, the boilers have been set higher than in normal practice when stokers are used, the tubes being fully twelve feet from the grates. This has resulted in an increase of efficiency in the combustion of gases particularly notable in coal containing a

Oster No. 300 B for straight and bent pipe and nipples from ¼ to 2", bolts from ⅜ to 1¼". Also furnished for belt drive.

Speedier Pipe-Threading

HERE'S the production you can count on from this machine:

53 seconds to thread
2-in. pipe on slow speed
20 seconds to thread
1-in. pipe on fast speed
1¾ minutes to cut off
2-in. pipe on fast speed
1½ minutes to cut off
1-in. pipe on fast speed
9 seconds to cut off
¼-in. pipe on fast speed

For prices and full details, write

The OSTER Manufacturing Company
East 61st Place, Cleveland, O., U.S.A.

ICE MACHINES Corliss Engines, Brewers and Bottlers' Machinery
The VILTER MFG. CO.
989 Clinton Street Milwaukee, Wis.

GAS, AIR, WATER, GASOLINE PUMPING by vacuum or pressure of air with
LEIMAN BROS. AIR PUMPS
ROTARY—POSITIVE

Widely used for gasoline measuring pumps, printing press paper feeders, package wrappers, bottle filling devices, fuel oil heating outfits, gas furnaces and blow pipes, agitating chemical and other solutions, sand blasting, testing for leaks, vacuum cleaning, priming engines and pumps, milking, vacuum chucks, blowing away stampings and cuttings from presses and machines.
Catalog No. 264-T-Bb
LEIMAN BROS. 81 WALKER ST., N. Y.

THE distribution of Bessemer Oil Engines is world wide. No other power equipment combines so many advantageous features. Less floor space needed, compactness and simplicity of design. No skilled labor required for its operation. These economies plus the low cost of operating on any grade of fuel oil make the Bessemer ideal for any power requirements 15 to 180 H. P. Write for catalog.

THE BESSEMER GAS ENGINE CO.
14 York Street, Grove City, Pa.

BESSEMER OIL ENGINES

Weber Crank-Pin Re-Turning Tool

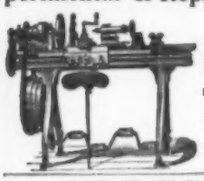
NO FILING
NO OFFSETTING
NO JIGS

A precision tool which will improve and speed up your motor machine work. Crank Pins of automobiles, trucks and tractors can be re-turned with the highest degree of accuracy with one setting of the crankshaft in the lathe on centers. Each crank pin can be re-turned in from 5 to 20 minutes. A micrometer dial enables the operator to make each pin exactly the same size, and each pin when finished must be perfectly round and parallel with the rest. The Weber tool is guaranteed to turn crank pins within as close limits of accuracy as any other known method. It is being used in many production plants for finishing work on crank shafts. An assortment of cutters is furnished with each tool to fit the pins of popular motors.

Write for our folder, and book, "Proof"

SAWYER-WEBER TOOL MFG. CO.
353 So. Alameda Street Los Angeles, Calif.

For Gunsmiths, Tool Makers, Experimental & Repair Work, etc.



From 9-in. to 18-in. swing. Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle.

W. F. & J. Barnes Co.
Established 1872.
1999 Ruby Street
Rockford, Ill.

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous BELL ASBESTOS MINES in Canada. We also carry fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

For anything you want in Asbestos, turn to

KEASBEY & MATTISON COMPANY
DEPT. S-1
AMBLER, PENNA., U. S. A.
Owners of the world's largest Asbestos Mines

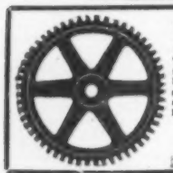
1/4 H. P., 110 volts, A. C., 60 cycles, single phase, 1750 R. P. M. MOTORS

LARGE QUANTITIES NEW WASHING MACHINE MOTORS

$22.75 Each

CHAS. R. JOHNSTON - Box 21 W. E., Pittsburgh, Pa.

GEARS
All Kinds—Small



The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.

Write for Catalogue

CHICAGO STOCKGEAR WORKS
20 South Jefferson Street Chicago

We Will Make It

Anything in a metal stamping or novelty produced from any metal and finished in any color.

Waterbury Button Co., Waterbury, Conn.

A New Book on a New Subject

BEHIND THE MOTION-PICTURE SCREEN

By AUSTIN C. LESCARBOURA

HERE, at last, is the wonder book of the screen. It takes the reader into that marvelous land where films are made, and where the camera reigns supreme. Every step in the making of a photo-play is taken up in proper turn, from the planning and writing of the scenario to the projecting of the finished film on the screen in the picture.

Talking pictures, natural-color pictures, a microscopic picture and all phases of the motion picture are treated upon in due turn. This book is printed on the highest grade coated paper. It contains 428 pages and over 300 illustrations. Bound in an attractive cloth cover. Size 6½ x 9½. $3.50; postage—15c in the East, 20c to Chicago, 30c to the coast.

One of the Most Attractive Books Ever Issued.

Scientific American Publishing Co.
233 Broadway New York

large percentage of volatile matter, and during those periods when the boilers are being forced. An electric locomotive is used for the removal of ashes, running directly under the discharge gates.

The new plant is in the center of one of the busiest and most congested industrial districts of Philadelphia, including in its range the great textile section known locally as Kensington and another district known as Richmond, given over largely to metal manufacturing plants. Power is supplied to these by underground cable at a potential of 13,200 volts and stepped down at substations for other industrial and for lighting requirements.

In common with all the other buildings of the company this structure, when complete, will present a most pleasing and stately architectural appearance. John T. Windrim, the architect, has put into it the kind of thought and effort that was confined, a few years ago, to memorial buildings and the like. This is in line with a definite policy of this company. It is based on the reasoning that the corporation is one of the city's biggest citizens and that it must do things in a big way.

Few persons realize the tremendous amount of work and equipment involved in the distribution of electric energy. For this one new plant there are being installed more than sixty miles of underground high voltage cable, 219 miles of single underground conduit and 1,200 miles of overhead lines. Each turbine in the plant is 48 feet long, 19 feet wide, 12 feet high and weighs 326 tons, and each is equipped with a 50,000 square foot condenser containing thirty-six miles of tubing, requiring 37,500 gallons of water per minute for condensing 369,000 pounds of steam every hour. For cooling the generators eight thousand cubic feet of washed air is provided every minute.

The Heavens in August, 1921

(*Continued from page 100*)

At the beginning of the month they remain in sight until 9 P. M., but by its close they are almost lost in the sun's rays. Uranus is in Aquarius and comes to opposition on the last day of the month. At that time he is in R. A. 22h. 38m. 35s., declination 9° 27′ south, and is moving 9s. east and 53″ south every day. He may be found 2½° west and 1½° south of the fourth magnitude star Lambda Aquarii, which is itself about one-third of the way from Beta Aquarii to Zeta Pegasi—these latter stars being marked on our map. Neptune is in conjunction with the sun on the 4th, and is invisible.

The moon is new at 3 P. M. on the 3rd, in her first quarter at 9 A. M. on the 10th, full at 10 A. M. on the 18th, and in her last quarter at 8 A. M. on the 26th. She is nearest the earth on the 3rd, farthest away on the 17th, and at her nearest again on the 31st. During the month she passes near Mercury and Mars on the 2nd, Neptune on the 3rd, Jupiter and Saturn on the 6th, Uranus on the 19th, Venus on the 30th, and Neptune and Mars on the 31st.

Mount Wilson Observatory
July 11, 1921.

A One-Piece Welded Structural Frame

(*Continued from page 101*)

more cheaply than either the screwed joint or the riveted or bolted joint. The matter of sanitation is simply one of trim construction that eliminates the ordinary recesses and surfaces for gathering and holding dirt.

The adaptation of tubing to structural work was first conceived to meet the difficulty of obtaining building material in the oil fields during the recent adverse conditions that prevailed in the Southwest, and the first building erected was a comparatively small structure fabricated from odds and ends of pipe, of which there is always an abundant supply in the oil districts. The success of this experimental step led to the erection of a larger building, the shop structure shown in the accompanying illustrations. In this building, 50 by 100 feet, all of the joints in the tubing were welded. The side, ends and roof are of corrugated iron and the floor of concrete. The trusses were separately tested by attaching a block and tackle to the bottom chords, one at a time, and hoisting a heavy motor truck clear of the ground.

The same company is now erecting a still larger building in Dallas. This structure will be 100 by 200 feet. The sides and ends will be of concrete, 10 inches in thickness, finished in marble; the roof will be sheathed with reinforced concrete slabs 2 inches thick; there will be a skylight 28 feet wide and two 2½-foot ventilator shafts, skylight and shafts extending the entire length of the building; the floor will be of concrete; and there will be steel sash windows and roller doors. A large chain hoist will be swung to one of the trusses for the loading and unloading of heavy weights.

This will be the largest building of its type yet erected, but it is stated that it by no means indicates the limit of dimensions to which the new welded tubular construction may be advantageously adapted; that any number of stories and any size of floor space can be built in this way. The new departure will be observed with considerable interest in building and engineering circles.

Sodium Hypochlorite

THERE are signs that a new household bleaching, deodorizing and disinfecting agent is about to become popular in the United States. It is called sodium hypochlorite and is a close relative of chloride of lime which contains calcium hypochlorite.

Sodium and calcium hypochlorites are very interesting compounds, because they contain two active elements, oxygen and chlorine, either of which without the other forms inert, stable compounds with the sodium or calcium, but when both are present in the proportions to form hypochlorites they act as two husbands of a single wife would, if they were well matched in strength and little afraid of each other—they are both disgusted with this family arrangement and look for a chance to escape and enter into more attractive combinations. Usually it is the oxygen that escapes, but when acids are mixed with the hypochlorites, the chlorine is driven out.

The oxygen in hypochlorites is loosely bound and very active. In the air, oxygen is rather sluggish unless the temperature is raised to the point where ordinary combustion takes place. We use matches to reach this temperature. But the oxygen of the air can be made active at ordinary temperatures in another way. If sunlight and moisture are present, the energy of the sun tears apart the sluggish oxygen molecules and leaves the oxygen in an active form that will destroy germs, bleach colors and sweeten things that have foul smells. This is why we put linen on the grass in the sunlight and sprinkle it with water. The hypochlorites obtain their energy not from sunlight but from electricity. The firmly bound and sluggish chlorine in common salt is torn away and set free by electricity, and made to pass into a compound containing oxygen, such as soda or slaked lime, forming the hypochlorites.

Chloride of lime is a useful household deodorizer and antiseptic because it is very powerful and quite cheap. It is used to sprinkle decaying vegetable and animal matter, it is put into ponds to disinfect them, which it does in such extreme dilutions as not to make the water unfit to drink, and when it is mixed with a weak acid solution such as urine or vinegar it generates chlorine enough to sweeten the air of a room without being strong enough to irritate the lungs and throat. But for bleaching the wash, to take the place of sunlight, air and moisture, chloride of lime is not well suited because it hardens water and prevents the detergent action of soap. For this purpose the sodium hypochlorite is better as it does not prevent the use of soap. It has been used for many years in the households of France for bleaching the wash and for whitening and sweetening wood floors and wood sinks.

Sodium hypochlorite will not remove all stains. There are some colors that are too fast to be destroyed by it, and this is really an advantage as it permits its use for bleaching the white part of printed calicoes and other partly colored cotton goods. The claims on the bottles of some makes of hypochlorite are in excess of its destructive power on colors.

A canvas tent left out in the air, moisture and sunlight for some years becomes rotten from the action of the oxygen of the air in excess. So too, if sodium hypochlorite is allowed to act too long on wash, or in too great concentration it will weaken the strength of the fabric, but if it is used with discretion according to the directions on the bottle, both as to strength and time, it will do more conveniently what air, sunshine and moisture do: bleach, sweeten and sterilize cotton and linen without destroying the fiber.

Sodium hypochlorite was used in the war to keep wounds aseptic, and it may find a use for this purpose as a household aseptic. It is used in laundries, and is now being introduced for family use under many names, being easily identified by the peculiar and not disagreeable smell, which one soon learns to associate with cleanliness and purity. It is not a poisonous antiseptic like carbolic acid, corrosive sublimate and formaldehyde, unless it is mixed with large amounts of strong mineral acids, when chlorine is set free in such amounts as to be dangerous to breathe. Next to soap and washing soda, sodium hypochlorite may quite possibly become the most commonly used household cleansing reagent.

Comparative Value of Timber Cut from Live and Dead Trees

PREJUDICE exists in certain quarters against the use of timber cut from dead trees, and some purchase specifications insist that only timber cut from live trees will be acceptable. As a matter of fact when sound dead trees are sawed into lumber, and the weathered or charred outside is cut away, there is no method known to the Forest Products Laboratory by which the lumber can be distinguished from that cut from live trees, except that the lumber from dead trees may be partly seasoned when sawed.

All the information available at the laboratory indicates that timber cut from insect or fire killed trees is just as good for any structural purpose as that cut from live trees of similar quality, providing the wood has not been subsequently injured by decay or further insect attack. If a tree stands on the stump too long after it is killed, the sapwood is likely to become decayed or badly infested by wood-boring insects, and in time the heartwood also will be similarly affected. The same thing is true of logs cut from live trees and not properly cared for. Until the wood becomes affected by these destructive agents, dead tree wood should be just as strong and just as durable as sound live tree wood.

In considering the subject it may be useful to remember that the heartwood of a living tree is entirely dead, and in the sapwood only a comparatively few cells are living. Most of the wood cut from trees is dead, therefore, regardless of whether the tree itself is living or not. Such being the case, purchase specifications, instead of providing that material must not be from dead trees, should state that material showing evidence of decay or insect infestation exceeding a specified limit will not be accepted.

That Word "Authority"

The idea of authority is an essential component of every well-ordered activity, for law and order the world over demand a centralized system of final responsibility that shall be recognized.

One of the great publishers of the country, discussing the Scientific American, said to its editor: "The greatest asset of your paper is its *truth* and *authority*." Waiving the first of these attributes because authority presupposes a strict adherence to truthfulness, we can explain the recognized authority of the Scientific American in a single glance at the editorial staff of this great publication.

On its staff the Scientific American has the leading scientific writers of the day; professors at Princeton, Cornell, M. I. T., Carnegie Institute, etc., well-known automotive engineers, naval constructors and bridge builders, foreign trade experts, the chairman of the National Research Council and important men in all the governmental Bureaus—all scientific reporters on the editorial staff of Scientific American.

The Scientific American publications are thus equipped to keep you posted authoritatively on the manifold activities of scientist, manufacturer, engineer and chemist.

These publications bring you translations of important notices in the European periodicals; they further scientific research in our industries, and they keep you well posted on all the progress in engineering, transportation, industrial equipment and mechanical improvements, chemistry, astronomy, aeronautics, etc.

In the combination subscription of the two publications, Scientific American and Scientific American Monthly, you have both the current news of science, industry, and mechanics in easily digested form and the more comprehensive treatment in the Monthly. The Scientific American editors are your chroniclers, of recognized authority and breadth of information limited only by the confines of science and industry.

The Scientific American Monthly is a 96-page journal, yearly subscription for which is $7. The weekly Scientific American is $6 per year—52 issues. In combination the two subscriptions are $11 per year. We will start your subscription for the Monthly from date to correspond with your subscription for the weekly Scientific American, billing you pro rata on the year-combination of $11.

SCIENTIFIC AMERICAN PUBLISHING COMPANY

WOOLWORTH BUILDING **233 BROADWAY, NEW YORK, N. Y.**

Westinghouse

ELECTRICAL APPARATUS FOR EVERY PURPOSE

This advertisement was prepared by a Westinghouse employee, a district office representative, whose business is not to write advertisements but to assist in the sale of Westinghouse products.

Electrification of Industry

To lighten the burdens of man; to increase his output and his income; to improve his work; to make his condition more tolerable and his life more complete; that is the function of Electricity and the mission of Westinghouse.

And this is the view of thousands of the employees who do their their daily work in the great Westinghouse organization. To them, Westinghouse is something more than a mammoth corporation, with its dozens of factories, its hundreds of offices, its thousands of workers; it is a great force, a power for civilization, a huge but skillful tool for the service of humanity.

They see its products not as so many motors or so much apparatus. They have a bigger vision of labor saved, of convenience added, of production increased. They think of the things which Westinghouse makes as contributions to the speed and smooth-running of the machinery of progress.

Westinghouse employees are proud of the great accomplishments of their company, whether expressed in the great steel-mill motors, the massive locomotives, the giant steam turbines and generators; or in the small applications that add so much to the convenience and comfort of every-day life—the little motors and heating devices that are used in homes all over the world.

Because, in the electrification of industry, and in the aids that it brings everywhere to those who have work to do, Westinghouse serves mankind.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
Offices in all Principal Cities · Representatives Everywhere

RESEARCH
Westinghouse Research Departments seek continually for the new and better ideas which Westinghouse engineering embodies in the electrical developments that mark the frequent forward steps in electrical progress.

MANUFACTURE
The Westinghouse manufacturing organization operates twenty-eight separate plants, each of them building, inspecting and testing their own specialized products, each peopled by men who know their work.

APPLICATION
Commercial engineers work out of forty-eight district offices to make careful studies of operating conditions, and to apply Westinghouse electrical apparatus to Industry as it should be applied.

SERVICE
"Westinghouse Service follows the sale." Service engineers see to it that Industry gets the maximum value, and the longest possible service, out of Westinghouse apparatus when it has been put to work.